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UMI
FISH POPULATIONS IN SOME IOWA FARM PONDS
IN RELATION TO PAST HISTORY AND MANAGEMENT

by

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A Dissertation Submitted to the
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The Requirements for the Degree of
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Major Subject: Economic Zoology

Approved:

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In Charge of Major Work

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Dean of Graduate College

Iowa State College

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I. INTRODUCTION

At the close of 1951 there were an estimated 3900 impounded ponds on farms in the state of Iowa that had been stocked with fish within recent years (Moorman, 1952). Most of these ponds are located in the southern half of the state where natural lakes are very few and where tight subsoils permit pond construction. Most farm ponds in the state are constructed primarily to be sources of water for livestock, and are only secondarily used for the production of fish and other purposes.

Interest in the use of farm ponds for the production of fish for recreation and table use was greatly revived in the late 1930's and early 1940's following experimental work done by H. S. Swingle and E. V. Smith, both of Alabama Polytechnic Institute. These two men were largely responsible for several notable advances in management methods for fish ponds, e.g.:

1. The use of complete inorganic fertilizers rather than organic ones for the improvement of ponds for fish.
2. The stocking of a simple combination of one carnivorous fish—the largemouth bass, and one forage fish—the bluegill.
3. The stocking of fingerling size fish of both species at ratios and rates proven to produce high quantities of harvestable size fish and based on known rates of growth.
As Swingle and Smith published the results of their experiments, interest grew, and states throughout the nation began to use and advocate the recommendations released by Alabama for stocking and managing farm fish ponds.

In states far removed from Alabama fish managers soon began to realize that the methods most satisfactory for Alabama were not necessarily as satisfactory everywhere else, particularly in the northern states. Fishery workers in most such states are now working to determine the management techniques best suited to their own situation.

The present investigation was instigated to determine the state of success of farm fish ponds in a limited area, and to look for factors in their past history that might have caused or contributed to any lack of success. A total of sixty such ponds in Marion County, Iowa, was covered in the field work that was carried on at irregular periods during the summers of 1949, 1950 and 1951.

Data for each pond covering its past history and fish populations are included in the Appendix. Each pond has been numbered for convenience, and that number is used in all references in the text to that particular pond.
II. DESCRIPTION OF THE STUDY AREA

A. Location

All of the farm fish ponds included in this study are located in Marion County, Iowa, in the south-central part of the state. To avoid bias possible in selecting ponds for certain qualities, the effort was made to investigate every pond known to have been stocked with bass and bluegills, with or without other species, within a delimited area. The area chosen was that part of the county west of the city of Knoxville and south of the Des Moines River, excepting Swan township in the northwest corner of the county. The area totals approximately 296 square miles. With some exceptions all ponds investigated are located within this area.

B. Soils

The following description of the topography and soils for the land included in the study area is based on Simonson and Benton (1941). The general topography consists of rolling or sharply rolling lands with occasional flats or divides. The soil parent materials are largely loess and glacial till with the loess of later origin. The loess covers most of the upland while the glacial till is exposed on the steeper slopes. Both of them have been generally leached of
calcium carbonate and are acid in reaction except on the steeper slopes, where leaching has not been severe. An inspection of the soils maps included in the work cited reveals that most of the study ponds appear to be located on silt loam soils in the Tama and Muscatine series of loess origin and the Shelby series of glacial till origin. Where eroded, these soils may expose silty clay loam or clay loam sub-soils.
III. METHOD OF PROCEDURE

A. Field Methods

A large majority of the farm fish ponds in Marion County have been stocked with fish obtained from the Fish and Wildlife Service, United States Department of Interior, and ordered and delivered through the office of the local Soil Conservation District. Since most of the ponds were also built with the technical assistance of the Soil Conservation District, the agency was able to furnish rather complete information on the location, size, time and rate of stocking and, to some extent, information on the past history of success or failure of some of the ponds. For some ponds this information was supplied by the farmer or by previous research workers. Where information on inspection results or fish populations came from sources outside this investigation the source has been acknowledged by a footnote on the data sheet for that pond in the Appendix.

The first inspection of a pond was of a preliminary nature, during which some of the general observations were made and the shallow waters of the pond were seined with a 15 to 20 foot "common sense" minnow seine. This type of seining gave fairly good samples of young of the year fish of the various species and of yearling bluegills, and on occasion, samples of adult bass, bluegills and bullheads. If the
preliminary inspection gave indications of fish populations suitable for the gathering of further data, then the pond was usually seined with a 60-foot seine of 3/8 inch mesh. The large seine could be worked effectively except in ponds where excessive amounts of filamentous algae "roped" the net (Pond 5), or where emergent vegetation prevented landing the seine at the shore line (Pond 44). Fish samples were also obtained with wire traps and by rotenone treatment of ponds in connection with population estimates or pond renovation.

Rotenone treatment of ponds involved applying derris root, containing 5% rotenone, at the rate of 1.35 pounds per acre foot of water (Krumholz, 1943). The derris powder was first mixed with a small amount of water to form a thin slurry, and this slurry then dispensed by broadcasting from a moving boat propelled by an outboard motor. The agitation and displacement of water in the wake of the outboard motor aided in mixing the chemical and the pond waters. Fish affected by the rotenone were collected by immediate seining, by dip netting, and by shoreline pick-up.

As the fish were collected, each was measured in inches of total length, and weighed in grams. If the fish were a bass, bluegill or crappie, a series of scales was taken from the left side of the body dorsal to the lateral line and even with the anterior end of the dorsal fin. Exceptions were that large bass were weighed in pounds on a larger balance and, in cases where a fish was being fin clipped on the right side for population estimates, the scales for aging were
also taken from that side. Fish were marked for population estimates by clipping the left pectoral fin close to the body of scaled fishes and the left pelvic fin of bullheads. Where a second population estimate was made at a later date the fin on the right side was clipped to avoid confusion between marks made on the different dates.

Populations were estimated by the well known Petersen marking and recovery technique in which a number of fish are captured, marked by fin clipping or other means, and returned to the water. After an interval of time fish are again collected and the numbers of marked and unmarked fish recorded. The total numbers of fish in the body of water can then be estimated by direct proportion on the basis that ratios of marked to unmarked fish should be the same in the population and in the subsequent collection. The validity of this method depends on the following assumptions:

1. The marked and unmarked fish have the same natural mortality.
2. There is no loss of marks, and all marks are readily recognized.
3. There is no significant recruitment of fish during the time between marking and recapture.
4. The marked and unmarked fish are equally vulnerable to capture.
5. There is either random mixing of the marked and unmarked fish or random effort to capture fish for the estimate.

For the population estimates in this study assumptions 1, 2 and 3 are believed valid because few marked fish were ever observed dead at any
of the ponds following marking, and the one to two day interval usually
left between marking and recovery did not permit either regeneration
of the severed fins or recruitment of young fish to the 3.5 inch
minimum size adopted for the estimates. Marked and unmarked fish
generally appeared equally vulnerable except where repeated seine
hauls were made during the same day to the point that fewer and fewer
fish per haul were captured. In such cases the percentage of marked
fish recaptured seemed high. Because the ponds were all small, one
acre or less, it was believed that the marked and unmarked fish had
excellent likelihood of mixing randomly in the time interval between
marking and recovery. Normally this was two days, but in a few in­
stances it was one day. In several ponds where a second estimate was
made later in the summer this interval amounted to as much as 30 days.
It was not generally possible to sample the ponds in a random fashion,
since there were usually only two to four beaches where the seine
could be landed.

In this study a mathematical elaboration of the Petersen method
by Schumacher and Eschmeyer (1943) was used to get a more accurate
estimate wherever a series of sample hauls was made. This formula
is:

-8-
\[ N = \frac{\sum n^2 (m + u)}{S_{nm}} \]

where 
- \( N \) = the population being estimated
- \( m \) = number of marked fish in the sample
- \( n \) = number of marked fish in the pond
- \( u \) = number of unmarked fish in the sample
- \( S \) indicates summation.

Use of the Schumacher and Eschmeyer formula also permits calculation of the sampling variance:

\[ s^2 = \frac{1}{k - 1} \left[ \sum \left( \frac{m^2}{m + u} \right) - \frac{S_{nm}}{n} \right] \]

where 
- \( s^2 \) = the sampling variance of the estimated number of fish
- \( k \) = the number of samples taken

and standard error of the estimate:

\[ \text{S.E.} = \sqrt{\frac{N^2 (s^2)}{S_{nm}}} \]

B. Laboratory Methods

Scales collected in the field were prepared in the laboratory for examination by mounting three to five scales from each fish between two microscope slides (Lewis and Garlander, 1949) and read in a dry state, without soaking. The scale image was projected with a microprojector onto a translucent glass plate, and tagboard strips were
used to record the relative position of the focus, the various annuli and anterior edge of one scale from each fish. The tagboard strips were fitted to a nomograph as described by Carlander and Smith (1944) to determine the length of the fish at the time of formation of the various annuli. Growth was calculated by the Dahl-Lea formula, where body and scale growth are assumed to be directly proportional, with zero as a base. While this formula does not permit the most accurate assignment of length for a given age, particularly for the first annulus, it is thought to be accurate enough for the present study. Furthermore the samples from the various ponds were too small and usually covered too narrow a size range to adequately describe the body-scale relationship and make corrections for differences in the growth of scale and fish.

Calculation of the length-weight relationship for each fish was made from the means of the lengths and weights of the various size groups according to the formula:

\[ W = c L^2 \]

or in logarithmic form:

\[ \log W = \log c + n \log L \]

where

- \( W \) = weight in hundredths of pounds
- \( L \) = total length in inches.

The condition factors or ponderal indices were calculated for each individual fish on the basis of the cube law

\[ W = c L^3 \]
where \[ W = \text{weight in hundredths of pounds} \]
\[ L = \text{total length in inches}. \]

To make the condition factor, \( C \), not a small fraction it was multiplied by 1000 and the formula converted to read:

\[
C = \frac{W \times 10^3}{L^3}
\]
IV. HISTORICAL FACTORS OF POSSIBLE INFLUENCE ON POND SUCCESS

Exactly what constitutes a successful fish pond has been a subject for considerable controversy, other than that the term "success" refers to the ability to produce fish desired by man. Swingle (1945) regards a proper balance between bass and bluegills as the most important factor in the production of good fishing in impounded water, and further states that sufficient bass must be available to keep the bluegill reproduction in check, and yet that there must not be so many bass present that too few bluegills will survive to produce sufficient food for the bass in turn. Bennett (1944) characterizes Illinois lakes that produced substantial yields of fish as containing populations in which the predatory species were numerous, as being free of dominant populations of any fish and of large populations of rough or forage fish, and as being subject to intensive but nonselective fishing. A successful fish pond is here regarded as one providing, or capable of providing, a crop of harvestable fish over a period of years.

For the 60 ponds included in this study, attempts have been made to determine the influence of various factors of past and present background of each pond on its success. It is not to be expected that all factors in the success or failure of a pond can be ascertained or that such factors ever operate entirely independently rather than in
combination with other factors. Since this study was observational rather than experimental in nature, it was not possible to detect some of the relationships between factors responsible for success or failure of a pond and its population.

A. Pond Size

Size of the ponds studied varied from one-tenth acre to two acres. The success of ponds under one-half acre was usually less than that of ponds between one-half and one acre (Table 1). However, both

<table>
<thead>
<tr>
<th>Pond area in acres</th>
<th>0.1</th>
<th>0.2</th>
<th>0.3</th>
<th>0.4</th>
<th>0.5</th>
<th>0.6</th>
<th>0.7</th>
<th>0.8</th>
<th>1.0</th>
<th>Over</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of ponds</td>
<td>2</td>
<td>7</td>
<td>19</td>
<td>10</td>
<td>8</td>
<td>6</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Percentage successful</td>
<td>0</td>
<td>43</td>
<td>37</td>
<td>40</td>
<td>50</td>
<td>67</td>
<td>67</td>
<td>100</td>
<td>50</td>
<td>50</td>
</tr>
</tbody>
</table>

successful and non-successful ponds were distributed well over the size range of all ponds, except that very small ponds were not successful.

Anderson (1948) found that in extremely small ponds, i.e., one-tenth acre, it was extremely difficult to maintain the proper number of bass to control the bluegill population, and recommended one-fourth acre as a reasonable minimum size for fish ponds. Swingle (1949) reports that unfertilized ponds of less than five-tenths acre and
fertilized ponds of less than one-fourth acre are too small to insure
good results with the bass-bluegill combination. Krumholz (1950a)
reported good success in one-tenth acre ponds with redear sunfish and
either largemouth or spotted bass but limited his recommendations for
the bass-bluegill combination to ponds of one acre or larger (Krumholz,
1950b). Ponds of at least one-half acre in size are recommended for
Iowa (Hull, Wilcox and Speaker, 1950).

B. Species Stocked

The largemouth black bass and the bluegill originally found most
suitable in Alabama (Swingle and Smith, 1940) have usually been considered
the basis for stocking plans for Iowa ponds. Other species have been
added on the basis of experience in small lakes and still others have
either been accidentally included in official stockings or have been
stocked by individuals based largely on their availability in nearby
streams. In Marion County, however, stocking of farm ponds has large­
dly been through the cooperative program of the Soil Conservation
District and, to a lesser degree, of the State Conservation Commission.
Accordingly the stocking of fish by individual farmers on a "catch-as-
catch-can" basis has been at a minimum, and relatively few different
species have been used. A list of those officially and unofficially
stocked in the study ponds follows, based on the names approved by
the American Fisheries Society (1948):
Officially stocked
Largemouth black bass .......... *Micropterus salmoides*
Bluegill ...................... *Lepomis macrochirus*
White crappie .................. *Pomoxis annularis*
Black bullhead .................. *Ameiurus melas*
Golden shiner ................... *Notemigonus crysoleucas*

Unofficially stocked
Green sunfish ................... *Lepomis cyanellus*
Orangespotted sunfish .......... *Lepomis humilis*
Fathead minnow .................. *Pimephales promelas*
Goldfish ........................ *Carassius auratus*

Bass and bluegills, used alone, made up the original stocking in 26 of the ponds and, in addition, were used subsequently in a number of ponds where the original population either failed, was added to, or was eliminated by rotenone treatment. Of the ponds where bass and bluegills composed the original stocking 15 were judged successful during the period of study 1949-1951. Bass-bluegill ponds normally contained reproducing populations and harvestable fish at two years of age but in some cases did not do so for at least another year. Two of the four best fishing ponds were bass-bluegill ponds, and a third

<table>
<thead>
<tr>
<th>Species stocked</th>
<th>Number of ponds</th>
<th>Percentage successful</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bass and bluegills</td>
<td>26</td>
<td>58</td>
</tr>
<tr>
<td>Bass, bluegills and bullheads</td>
<td>18</td>
<td>22</td>
</tr>
<tr>
<td>Bullheads</td>
<td>7</td>
<td>0</td>
</tr>
<tr>
<td>Bass, bluegills and crappies</td>
<td>3</td>
<td>100</td>
</tr>
<tr>
<td>Bass, bluegills and golden shiners</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>Miscellaneous species</td>
<td>3</td>
<td>67</td>
</tr>
<tr>
<td>Bluegills and bullheads</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>
was essentially so during the study. Of the bass-bluegill ponds that failed, the suspected or known cause was winterkill and is discussed elsewhere.

Bass, bluegills and bullheads were frequently stocked as a combination prior to 1946. At that time the bullheads were withdrawn from the combination by both state and federal agencies offering fish for ponds. Of 13 ponds originally stocked with this combination, four were successful during the study. In two of the four, bullheads were no longer in evidence either as young or as adults, one contained sub-adult and adult bullheads but no young bullhead reproduction during the three years, and only the fourth pond still showed successful bullhead reproduction, and that seven years after the original stocking was made. The failures of bass-bluegill-bullhead ponds have been largely assigned to specific causes or combinations of causes and are discussed elsewhere.

In two of the ponds (Pond 23 and Pond 29) miscellaneous fishes, including crappies, green sunfish, orangespotted sunfish and golden shiners, were either accidentally included in the original stocking or were subsequently stocked by persons unknown. Both of the ponds had overcrowded populations of these fishes, and few bass or none at all. There is, in this series of 14 bass-bluegill-bullhead ponds that failed, no indication that the bullheads were responsible for the poor survival or poor reproduction of either bass or bluegills, although they may have been involved in slow growth of these species. In
ponds where this combination occurred, the bass were apparently successful in reaching maturity and in controlling the reproduction of the bullheads.

Of seven ponds originally stocked only with bullheads none had maintained or showed promise of maintaining annual crops of harvestable fish. Two of them contained stunted populations; two of them had received over-stockings of bass and bluegills, both of which failed.

Successful populations of fish were established in all of the three ponds originally stocked with a bass-bluegill-crappie-bullhead combination or a bass-bluegill-crappie combination. Crappies were still present and reproducing in these ponds, while bullheads had almost entirely vanished. One of these ponds furnished excellent fishing (Pond 6).

Three of the ponds had received stockings of miscellaneous species of fish apparently obtained from nearby streams or ponds. In two of these, bass, bluegills and crappies were maintaining themselves and the ponds were judged to be successful (Pond 2 and Pond 42).

One pond (Pond 12) had been stocked with a combination of bass, bluegills and golden shiners. At the end of six years the golden shiners were still in evidence but in very small numbers, while populations of bass and bluegills were well established.

The final two ponds had been originally stocked with bluegills and bullheads, without any essentially predatory fish such as bass. One of these had subsequently received a stocking of bass, and populations
were balanced. The other pond had become overcrowded with bullheads and was treated with rotenone during this study and restocked with bass and bluegills (Pond 55).

The ratios of bluegills to bass actually stocked in this series of ponds varied considerably from the ten to one ratio advocated and supposedly in vogue. The variation was from a low ratio of four to one (Pond 43) to a high ratio of 25 to one (Pond 13). There is no discernible correlation between stocking ratios of bluegills to bass and ultimate success of the pond and its populations (Table 3).

While almost all the ponds were stocked with fingerling size fish according to existing recommendations, one (Pond 45) had been stocked with fry and was an effective and balanced pond 14 to 16 years later.

The rates of stocking first used are known for 50 of the 60 study ponds, and are expressed in terms of the number of bluegills per acre (Table 4). For this purpose crappies were converted to the equivalent number of bluegills according to Edminster (1947). The rates of stocking vary from 200 to 2500 bluegills per acre, with the majority in the range of 300 to 1000 per acre. There is no apparent relationship between rates of stocking and the likelihood of future success, at least within our range of data.
Table 3. Stocking Rates and Success, 47 Farm Fish Ponds

<table>
<thead>
<tr>
<th>Stocking Ratios</th>
<th>Number</th>
<th>Percentage successful</th>
<th>Stocking Ratios</th>
<th>Number</th>
<th>Percentage successful</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bluegills to Bass</td>
<td>of ponds</td>
<td></td>
<td>Bluegills to Bass</td>
<td>of ponds</td>
<td></td>
</tr>
<tr>
<td>4 to 1</td>
<td>1</td>
<td>100</td>
<td>11 to 1</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>5 to 1</td>
<td>--</td>
<td>--</td>
<td>12 to 1</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>6 to 1</td>
<td>1</td>
<td>100</td>
<td>13 to 1</td>
<td>5</td>
<td>60</td>
</tr>
<tr>
<td>7 to 1</td>
<td>2</td>
<td>0</td>
<td>14 to 1</td>
<td>2</td>
<td>100</td>
</tr>
<tr>
<td>8 to 1</td>
<td>5</td>
<td>0</td>
<td>15 to 1</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>9 to 1</td>
<td>1</td>
<td>100</td>
<td>16 to 1</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>10 to 1</td>
<td>27</td>
<td>44</td>
<td>25 to 1</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 4. Stocking Rates of Bluegills and Success, 50 Farm Fish Ponds

<table>
<thead>
<tr>
<th>Stocking Ratios</th>
<th>Number</th>
<th>Percentage successful</th>
<th>Stocking Ratios</th>
<th>Number</th>
<th>Percentage successful</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bluegills per Acre</td>
<td>of ponds</td>
<td></td>
<td>Bluegills per Acre</td>
<td>of ponds</td>
<td></td>
</tr>
<tr>
<td>200</td>
<td>3</td>
<td>33</td>
<td>1400</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>300</td>
<td>5</td>
<td>60</td>
<td>1500</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>400</td>
<td>4</td>
<td>25</td>
<td>1700</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>500</td>
<td>14</td>
<td>36</td>
<td>2000</td>
<td>3</td>
<td>33</td>
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<td>600</td>
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<td>2500</td>
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<td>700</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>800</td>
<td>6</td>
<td>66</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>900</td>
<td>1</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1000</td>
<td>7</td>
<td>43</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
C. Age of Stocking

In the ponds studied, there was no noticeable trend toward a decrease in success with increasing age (Table 5). Ponds that had gone only one year since their original stocking are not included in the table because their ultimate success or failure could not be judged at that age. About half of the ponds two and three years old were successful. Ponds six years old at the time they were first inspected

<table>
<thead>
<tr>
<th>Age of pond in years</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of ponds</td>
<td>25</td>
<td>8</td>
<td>10</td>
<td>11</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Percentage successful</td>
<td>48</td>
<td>50</td>
<td>30</td>
<td>36</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

during this study represent the earliest ponds stocked through the cooperation of the local Soil Conservation District; the single pond 15 years of age was stocked through the efforts of a work group of the Civilian Conservation Corps assigned to soil conservation practices. The success listed for the ponds over five years old probably does not indicate an increase in success with increased age, but perhaps means only that successful ponds retain their identity while unsuccessful ones drop from both records and memory.
D. Farmer Management

For a farmer to secure free fish to stock his pond from either the Iowa Conservation Commission or the United States Fish and Wildlife Service, it has been necessary that the pond and the area about it conform to certain physical specifications and to certain land management practices, in order that there be some assurance that the fish would not be wasted in unsuitable environments (Davidson, 1947; Hull, Wilcox and Speaker, 1950).

Fencing to keep livestock from wading in the pond has always been required or recommended, and is one of the immediate pond management practices available to the farmer. Except for ten ponds where no attempt to fence was ever made, all pond owners had established fences or were otherwise holding the pond unavailable to livestock. In some cases the cattle barrier was not maintained every year or in some the pond area was deliberately used as an additional small pasture for a few animals for a short time each year. The influence of fencing on the ability of the pond to produce harvestable fish is not discernible from the present data.

Fertilization of ponds to increase the abundance of fish foods was never mandatory, but until recent years was usually recommended. Only two farmers had ever complied with the recommendation in a meaningful way, and both of these farmers were deeply interested in their ponds and their fish. In one of these fertilized ponds winter-kill was a regular occurrence, and the fertilization may have
contributed thereto (Ball, 1950).

Because full-time could not be devoted to field studies during the summer months it was not possible to obtain anything more than sketchy information on the amount of fishing occurring in the study ponds. On the basis of limited information it is possible, however, to estimate the number of fishing parties and the fish harvest for 18 of the ponds, including all of those showing the best populations of bass and blue-gills (Table 6).

Table 6. Estimated Number of Fishing Parties at Selected Farm Ponds, June-August, 1951

<table>
<thead>
<tr>
<th>Number of Fishing Parties per Month</th>
<th>Pond number</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>18</td>
</tr>
<tr>
<td>1</td>
<td>4, 9, 14, 25, 29, 30, 47</td>
</tr>
<tr>
<td>1 to 2</td>
<td>51</td>
</tr>
<tr>
<td>1 to 3</td>
<td>28</td>
</tr>
<tr>
<td>2</td>
<td>33, 57</td>
</tr>
<tr>
<td>1 to 4</td>
<td>43</td>
</tr>
<tr>
<td>3 to 4</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>6, 45</td>
</tr>
<tr>
<td>6 to 8</td>
<td>12</td>
</tr>
<tr>
<td>8</td>
<td>42</td>
</tr>
</tbody>
</table>

Apparently many of the ponds were scarcely fished during the summer. To the best of our knowledge there were only six ponds that were visited by as many as four fishing parties per month. These six ponds had one or more of these characteristics in common:
1. They contained balanced populations of fish.
2. The sizes of fish were relatively large.
3. The pond was visible from the road or was otherwise easily accessible to the fishermen.

It is noteworthy that two of the ponds most heavily fished (Pond 12 and Pond 45) contained quantities of relatively large bluegills. Both were owned by farmers who were very conservative about giving permission to fish so that most of the fishing done was without such permission. Harvest at the six most heavily fished ponds would probably not exceed 65 pounds of fish per acre per year, and harvest at the other 12 ponds in the table would not exceed 20 pounds per acre per year.

E. Turbidity

No attempt was made to measure water turbidity due to silt and clay, other than that its presence was recorded. Some of the turbidity was definitely due to roiled material from the bottom mud and was attributed to bullheads (Ponds 33, 39 and 46). In some cases turbidity was temporary, following rain. In 12 cases, however, the turbidity appeared to be due to fine suspended clay that did not settle out for long periods of time or was never observed to settle out during an entire summer. Many of these ponds were on eroded hillsides and were perhaps in areas of high clay subsoils. Turbidity of a permanent or semi-permanent nature affects the growth of plankton algae, and reduces the visibility for predatory fish.
like the bass to feed (Swingle, 1949). In the study ponds turbidity did not prevent the reproduction of bass but sometimes seemed to delay growth (Ponds 4, 17, 43) as evidenced by small two year old bass the second summer following stocking.

F. Vegetation

The presence of rooted aquatic vegetation in ponds has been a deterrent to the production and utilization of fish in many localities (Swingle, 1945; Edminster, 1947; Anderson, 1948; Ball and Tait, 1952). In our series of ponds few species of aquatics occurred, as follows:

Typhaceae

*Typha latifolia* L

Zosteraceae

*Potamogeton foliosus* Raf.

*Potamogeton nodosus* Poiret

*Potamogeton Spirillus* Tuckerm

Alismataceae

*Alisma subcordatum* Raf.

Cyperaceae

*Scirpus atrovirens* Willd.

The common cattail (*Typha latifolia*) was the most obvious aquatic about many of the ponds. In most ponds where it occurred there were only a few plants growing in a loose clump in water six to 12 inches
deep. In a few ponds the cattails apparently spread rapidly in a few years time to occupy extensive portions of the shoreline and of water up to three feet deep (Ponds 13, 28, 44).

The pondweed (Potamogeton nodosus) was the most common of the floating-leafed plants, occurring in eight ponds in more or less company with the other Potamogetons. In one pond (Pond 44) these pondweeds formed an almost complete band around the shore to a depth of at least three feet, greatly hindering the use of the pond for bank fishing. As far as could be told this vegetation was not depressing the production of bluegills or the feeding of bass, both species were present in several age classes and the population was in balance.

Some forms of algae were prominent members of the pond flora in addition to the above rooted plants. Filamentous algae were present in small patches in a number of ponds and in large amounts in one pond each year. In Pond 5 the algal mat was so heavy by midsummer, 1949-1951, that it clogged the meshes in the 60-foot seine used to sample fish populations, and caused it to roll up so badly that seining was ineffective. The spawning of bluegills was not eliminated by the mats of algae but may have been reduced (Ball and Tanner, 1951).

Blooms of plankton algae were of common occurrence in the ponds. These blooms of algae varied in color from deep green to dark brown and probably represent a number of species. They were never present in waters containing large amounts of suspended clay.
G. Winterkill

The death of fish when oxygen is depleted beneath ice and snow covers has been widely recognized in the north central states (Greenbank, 1945; Bennett 1945b; Cooper and Washburn, 1949). For the Marion county farm ponds information on winterkill has been gathered from two sources: from farmers and others who observed numbers of dead fish in ponds following the breakup of ice, and from pond histories that indicate a sudden mass disappearance of bass, of bluegills, or of both. While in many cases there is no evidence as to the time of year that such fish have disappeared, heavy mortality during the summer was observed only once (Pond 16) by the pond owners concerned while winterkill was observed frequently. The chances of mass mortality of fish being unobserved are probably greater in the winter than the summer.

Fish populations in 31 of the ponds have at one time or another suffered winterkill (Table 7). In 15 ponds bass were eliminated but some bluegills survived, in two ponds the reverse was true, with bluegills winterkilling but some bass surviving. The differential between the species may represent a difference in tolerance to low oxygen levels (though Cooper and Washburn, 1949, found none) or, more likely, may represent a difference in habits of location in the pond during wintertime, or ability of some individuals to locate and utilize pockets of water containing sufficient oxygen for survival.
Complete kills of both bass and bluegills occurred in 18 ponds. In only five of these was the kill complete in the sense that all species of fish present were eliminated, for the 13 other ponds contained bullheads and these survived in some numbers.

Table 7. Known or Suspected Winterkills of Fish in Marion County Farm Ponds

<table>
<thead>
<tr>
<th>Species eliminated by kill</th>
<th>Pond numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bass, but not bluegills</td>
<td>3,19,19,20,24,29,30,32,35,37,</td>
</tr>
<tr>
<td></td>
<td>40,47,48,49,50,59</td>
</tr>
<tr>
<td>Bluegills, but not bass</td>
<td>3,27</td>
</tr>
<tr>
<td>Bass and bluegills</td>
<td>9,10,11,15,16,16,16,20,23,27,31</td>
</tr>
<tr>
<td></td>
<td>35,36,39,40,41,47,49,55,56</td>
</tr>
<tr>
<td>Some bass and some bluegills</td>
<td>4,15,25,37,45</td>
</tr>
</tbody>
</table>

Some ponds are inclined to winterkill repeatedly, as is shown by the frequency of some pond numbers in the table.

Winterkill is believe to be a major factor in the lack of population balance and success of the Iowa ponds. The population resulting after an incomplete kill is radically different than that present before, and the change is usually unfavorable for angling (Bennett, 1948a).
V. THE MINNOW SEINE TECHNIQUE AS AN INDICATOR OF POND SUCCESS

The technique of using test hauls with a minnow seine to determine the relative balance between bass and bluegills was first publicized by Swingle (1945) and then described in more detail by Anderson (1948). The method depends on a study of young fish present in the shallows of the pond from July 1st to September 15th as revealed by the seining. If young-of-year of both species are present, the populations are judged "in balance". The pond is judged overcrowded with bluegills if the seine shows many two-inch to three-inch bluegills, no young bass and few if any young bluegills. The pond is overcrowded with bass if there are some young-of-year bluegills, no two-inch to three-inch bluegills and no young-of-year bass. The value of this technique has been variously discussed (Bennett, 1945b; Allan, 1950; Bennett, 1950; Krumholz, 1951; Fessler, 1950).

The Swingle minnow seine technique was used in the preliminary inspection of the Iowa ponds as mentioned earlier. Judged entirely on the basis of what the minnow seine revealed on the first inspection and on the analysis procedure recommended, 22 of the 60 ponds were judged as being "in balance". Later judgment of these ponds as revealed by seining with a large seine and by age analysis that year or following years resulted in a list of 27 ponds in which the bass
and bluegill populations were adequate and appeared capable of producing an annual harvestable crop of fish. The two techniques are compared in Table 5. The table shows that the two methods differently classified 13 ponds. Four of these winterkilled following the minnow seine analysis of being in balance; the tabulated listings are for different years and are not therefore comparable.

Table 5. Comparison of Results of Swingle Method and Population Study Method of Determining Fish Population Condition in Marion County Farm Ponds

<table>
<thead>
<tr>
<th>Ponds in balance by Swingle method and by population study</th>
<th>1, 2, 4, 5, 6, 8, 17, 22, 26, 27, 34, 38, 44, 45, 52, 54, 57, 58</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ponds unbalanced as shown by both methods</td>
<td>3, 7, 10, 11, 13, 15, 16, 19, 20, 21, 23, 24, 29, 31, 32, 35, 36, 37, 39, 40, 41, 46, 47, 48, 49, 53, 55, 56, 59</td>
</tr>
<tr>
<td>Ponds in balance by Swingle method but unbalanced by population study</td>
<td>9*, 27*, 30*, 50*</td>
</tr>
<tr>
<td>Ponds unbalanced according to Swingle method, but in balance by population study</td>
<td>12, 14, 16, 25, 33, 42, 43, 51, 60</td>
</tr>
</tbody>
</table>

* One year between Swingle method check and population study with a winterkill intervening.

As might be expected, the more detailed and time consuming method of population analysis made apparent situations in some ponds that were not revealed by the minnow seine inspection. In four ponds (Ponds 12, 14, 25, and 51) young-of-year bass were not
located by minnow seine but were so located either later that year
by the larger seine or by age analysis of scales of fish captured.
In four other ponds (Ponds 18, 33, 42, and 60) the bass did not
reproduce in the year of inspection but did so in subsequent years.
In Pond 43 the minnow seine did not reveal a heavy population of
bullheads and slow growing bass that subsequently came into popula-
tion balance.

Other errors in the minnow seine technique were revealed by
later inspections of the ponds. Bluegills sometimes hatched late
in the season and were found by inspections in August where they
had not been in evidence earlier. The minnow seine sometimes gave
an erroneous picture of the species in the pond, particularly where
a variety of species had been stocked by the farmer from creeks or
elsewhere. Bullheads seemed to often escape the small seine and
heavy populations not be detected. In some ponds, particularly
where suspended clay or other causes slowed growth of bass, there
was no reproduction of bass the second spring following stocking,
but was the year following.
VI. FISH POPULATIONS

A. Largemouth Black Bass

The largemouth black bass has been widely recognized and utilized as the predatory species in fish combinations for warm-water ponds (Swingle and Smith, 1940; Bennett, 1943). Bass grow rapidly under favorable conditions with an abundant food supply and they serve as a control on the large numbers of fry produced by other fishes. An indication that even young-of-the-year bass may be active predators was obtained at Pond 6 on July 15, 1950 where both young white crappies and young black bullheads were found in the distended stomachs of young-of-year bass.

During the investigation varying numbers of bass were collected from 19 ponds. Collections were made primarily with seine but in some cases by treatment of the pond with rotenone or by trapping and angling. Since bass were not readily taken by seine most of the ponds are represented by small numbers of bass and by unequal size and age distribution of those collected. As a result the data from all of the ponds have been combined for most of the study.

1. Age and growth

   a. Length-weight. The length-weight relationship was determined for 257 bass varying in length from 3.5 inches to 17.5 inches. Fish less than 3.5 inches in total length were not included in the
computation because it was felt that the 500 gram capacity balance used was not completely reliable at the smaller weights. The length-weight equation in logarithmic form for the bass is:

$$\log W = -1.450 + 3.136 \log L$$

where $W$ = the weight in hundredths of pounds and $L$ = the total length in inches.

As indicated by the formula, individual bass increased in weight somewhat more rapidly than the cube of the total length. Because of the relatively few fish ten inches and larger involved in the computations, the formula will probably give estimated weights with less accuracy in that size range than in the smaller sizes.

b. Condition factors. The condition factors or ponderal indices, as a measure of relative plumpness, were computed for the 257 bass included in the length-weight determination (Table 9). There is a general tendency for larger condition factors and therefore greater plumpness to be associated with the larger fish, as would be expected since the weight increased more rapidly than the length cubed. The largest fish listed did not have the largest condition factor however. The largest condition factor determined for any individual bass, 82.5, was for an Age Group III fish measuring 12.2 inches, and the lowest factor, 27.3, was for an Age I fish measuring 3.8 inches from the heavy population of yearling bass in Pond 25.

Comparison of these condition factors with those of bass from other areas indicates that the bass in the present study were in
Table 9. Total Length, Weight, and Condition of Largemouth Black Bass, 19 Farm Ponds, Marion County, Iowa, 1950 and 1951

<table>
<thead>
<tr>
<th>Mean total length (inches)</th>
<th>Number of fish</th>
<th>Mean weight (lbs. x 100)</th>
<th>Mean condition (C)</th>
<th>Estimated weight* (lbs. x 100)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.8</td>
<td>18</td>
<td>2.14</td>
<td>39.7</td>
<td>2.33</td>
</tr>
<tr>
<td>4.0</td>
<td>19</td>
<td>3.02</td>
<td>41.5</td>
<td>2.74</td>
</tr>
<tr>
<td>4.7</td>
<td>78</td>
<td>4.01</td>
<td>40.0</td>
<td>4.55</td>
</tr>
<tr>
<td>5.1</td>
<td>40</td>
<td>5.65</td>
<td>41.7</td>
<td>5.68</td>
</tr>
<tr>
<td>5.7</td>
<td>13</td>
<td>6.93</td>
<td>40.5</td>
<td>8.33</td>
</tr>
<tr>
<td>6.1</td>
<td>13</td>
<td>10.28</td>
<td>44.2</td>
<td>10.29</td>
</tr>
<tr>
<td>6.7</td>
<td>5</td>
<td>14.86</td>
<td>49.4</td>
<td>13.82</td>
</tr>
<tr>
<td>7.2</td>
<td>2</td>
<td>17.95</td>
<td>48.1</td>
<td>17.32</td>
</tr>
<tr>
<td>7.6</td>
<td>6</td>
<td>19.30</td>
<td>43.4</td>
<td>20.52</td>
</tr>
<tr>
<td>8.2</td>
<td>13</td>
<td>26.71</td>
<td>47.9</td>
<td>26.03</td>
</tr>
<tr>
<td>8.6</td>
<td>8</td>
<td>29.30</td>
<td>46.1</td>
<td>30.24</td>
</tr>
<tr>
<td>9.1</td>
<td>5</td>
<td>34.20</td>
<td>44.7</td>
<td>36.10</td>
</tr>
<tr>
<td>9.5</td>
<td>1</td>
<td>49.40</td>
<td>57.8</td>
<td>41.31</td>
</tr>
<tr>
<td>10.4</td>
<td>1</td>
<td>54.00</td>
<td>41.1</td>
<td>54.86</td>
</tr>
<tr>
<td>10.9</td>
<td>1</td>
<td>62.50</td>
<td>48.3</td>
<td>63.57</td>
</tr>
<tr>
<td>11.0</td>
<td>4</td>
<td>67.70</td>
<td>50.5</td>
<td>65.43</td>
</tr>
<tr>
<td>11.6</td>
<td>7</td>
<td>82.20</td>
<td>52.2</td>
<td>77.30</td>
</tr>
<tr>
<td>12.2</td>
<td>5</td>
<td>98.00</td>
<td>53.7</td>
<td>90.58</td>
</tr>
<tr>
<td>12.6</td>
<td>3</td>
<td>93.90</td>
<td>47.3</td>
<td>100.22</td>
</tr>
<tr>
<td>13.1</td>
<td>1</td>
<td>125.00</td>
<td>55.6</td>
<td>113.20</td>
</tr>
<tr>
<td>13.6</td>
<td>7</td>
<td>108.00</td>
<td>51.8</td>
<td>127.23</td>
</tr>
<tr>
<td>14.0</td>
<td>2</td>
<td>164.70</td>
<td>60.4</td>
<td>139.34</td>
</tr>
<tr>
<td>14.6</td>
<td>2</td>
<td>175.00</td>
<td>56.8</td>
<td>159.03</td>
</tr>
<tr>
<td>15.2</td>
<td>2</td>
<td>155.00</td>
<td>43.7</td>
<td>180.30</td>
</tr>
<tr>
<td>17.5</td>
<td>1</td>
<td>256.90</td>
<td>47.9</td>
<td>280.55</td>
</tr>
</tbody>
</table>

Total: 257
Mean: 43.3

*Log W = -1.450 + 3.136 Log L.
relatively poor condition (Table 10). Bennett (1948c) sets the following standards for condition factor, C, for the largemouth black bass: poor 35 - 45; average 46 - 55; good 56 - 65. The low mean condition factor of 43.3 may indicate a shortage of food or unavailability of food under a situation such as muddy water.

Table 10. Comparison of Condition Factors for Largemouth Black Bass from Various Localities

<table>
<thead>
<tr>
<th>Authority and Location</th>
<th>Number of fish</th>
<th>Range in total length (inches)</th>
<th>Range in subgroup Mean C</th>
<th>Mean C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beckman, 1948 Michigan</td>
<td>1100</td>
<td>2.2-18.3</td>
<td>46 - 47</td>
<td></td>
</tr>
<tr>
<td>Thompson and Bennett, 1939 Illinois, Sportsman's Lake</td>
<td>146</td>
<td>4.0-21.0</td>
<td>39.3-62.4</td>
<td>--</td>
</tr>
<tr>
<td>Lewis, 1950 Iowa, Red Haw Lake</td>
<td>62</td>
<td>4.6-13.9</td>
<td>--</td>
<td>46.9*</td>
</tr>
<tr>
<td>Lewis, 1950 Iowa, East Lake</td>
<td>64</td>
<td>2.9-21.0</td>
<td>--</td>
<td>46.1*</td>
</tr>
<tr>
<td>Ruhr, 1952 Iowa, Ike Lake</td>
<td>61</td>
<td>6.5-11.4</td>
<td>39.9-67.1</td>
<td>51.0</td>
</tr>
<tr>
<td>Present Study Iowa, Farm Ponds</td>
<td>257</td>
<td>3.3-15.2</td>
<td>39.7-60.4</td>
<td>43.3</td>
</tr>
</tbody>
</table>

*Converted from coefficient of condition, X, by use of formula $C = 36.1 r^2 K_m$; where $r$ = ratio of standard to total length for the population concerned, and $K_m$ = coefficient of condition in the metric system.

c. Growth. In the study of growth it was assumed that the generally accepted scale method (Greaser, 1926; Van Oosten, 1929) was valid for bass from farm ponds. Evidence that supports this assumption is as follows:
1. There is correlation between the size of the fish and its age, both from individual ponds and from ponds as a whole.

2. A dominant year-class observed as young-of-the-year in 1949 in Pond 25 could be followed in 1950 and 1951 and had gained an annulus each year (Table 11).

3. In those ponds where the bass were of known age, there was complete agreement between the number of annuli and the known age. In Ponds 13, 33, 43, 51 and 59 the bass captured were of known age under conditions such that there was little likelihood of confusing them with bass of younger ages.

Table 11. Observed Total Lengths of 1949 Year-Class of Largemouth Black Bass, Pond 25, During a Three Year Period

<table>
<thead>
<tr>
<th>Date of capture</th>
<th>Number of fish</th>
<th>Mean total length in inches</th>
<th>Age in years</th>
</tr>
</thead>
<tbody>
<tr>
<td>June 25, 1949</td>
<td>17</td>
<td>2.35</td>
<td>0</td>
</tr>
<tr>
<td>July 12, 1949</td>
<td>25</td>
<td>2.89</td>
<td>0</td>
</tr>
<tr>
<td>June 15, 1950</td>
<td>15</td>
<td>3.99</td>
<td>1</td>
</tr>
<tr>
<td>July 20, 1950</td>
<td>119</td>
<td>4.91</td>
<td>1</td>
</tr>
<tr>
<td>July 10-11, 1951</td>
<td>13</td>
<td>5.33</td>
<td>2</td>
</tr>
</tbody>
</table>

Since about one-third of the bass from which scales were collected came from Pond 25, a pond which was classed as being overcrowded with bass, the growth data for this pond (Table 12) are given separately from that for the other ponds (Table 13). In Pond 25 the 1949 year class showed very slow growth, but the older bass grew very rapidly.
Table 12. Calculated and Measured Total Lengths of \( \frac{1}{4} \) Large-mouth Black Bass from Pond No. 25, Marion County, Iowa

<table>
<thead>
<tr>
<th>Year collected class</th>
<th>Age</th>
<th>Number of fish</th>
<th>Average calculated length in inches at annulus</th>
<th>Length at capture</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>1 2 3 4</td>
<td></td>
</tr>
<tr>
<td>1950</td>
<td>I</td>
<td>29</td>
<td>3.44</td>
<td>4.75</td>
</tr>
<tr>
<td></td>
<td>III</td>
<td>4</td>
<td>4.20 8.08 12.98</td>
<td>13.10</td>
</tr>
<tr>
<td></td>
<td>IV</td>
<td>1</td>
<td>4.20 8.70 10.80 13.50</td>
<td>14.00</td>
</tr>
<tr>
<td>1951</td>
<td>II</td>
<td>10</td>
<td>2.86 5.73</td>
<td>8.38</td>
</tr>
</tbody>
</table>

Mean total
Length, inches 3.39 6.55 12.54 13.50
Annual increments 3.39 3.25 4.34 2.70
Sum of increments 3.39 6.64 10.98 13.68

Table 13. Calculated and Measured Total Lengths of 93 Large-mouth Black Bass from 18 Farm Ponds, Marion County, Iowa 1950 and 1951

<table>
<thead>
<tr>
<th>Age class of fish</th>
<th>Number of fish</th>
<th>Average calculated length in inches at annulus</th>
<th>Length at annulus</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1 2 3 4</td>
<td>5</td>
</tr>
<tr>
<td>I</td>
<td>62</td>
<td>5.51</td>
<td>7.50</td>
</tr>
<tr>
<td>II</td>
<td>7</td>
<td>4.12 8.99</td>
<td>10.03</td>
</tr>
<tr>
<td>III</td>
<td>13</td>
<td>5.31 9.56 12.78</td>
<td>13.48</td>
</tr>
<tr>
<td>IV</td>
<td>9</td>
<td>4.62 8.73 11.70 13.33</td>
<td>13.79</td>
</tr>
<tr>
<td>V</td>
<td>2</td>
<td>3.80 8.35 10.17 12.75 14.30</td>
<td>15.20</td>
</tr>
</tbody>
</table>

Mean total
Length, inches 5.25 9.11 12.16 13.22 14.30
Annual increments 5.25 4.37 3.01 1.80 1.55
Sum of increments 5.25 9.62 12.63 14.43 15.98
after they were large enough to eat the middle-sized bluegills and bass.

When compared with rates of growth reported for other bodies of water it is seen that the bass from the other Iowa ponds show above average growth (Table 14). The fish at Onized Lake, Illinois, as reported by Bennett (1945) were under heavy fishing pressure by anglers and apparently were at less than the full carrying capacity of the lake, and were thus able to make large gains in growth. Somewhat the same explanation may be possible for the rapid growth in Iowa farm ponds, since many of the ponds were young in years and may not have been at full carrying capacity.

Data from the table indicate that on the average the bass reach the length of ten inches during their third summer of life. Since ten inches is the minimum legal length for largemouth bass in Iowa, bass fishing in the average farm pond can usually legally begin the second summer after stocking.

2. Reproduction

Swingle and Smith (1943) have reported the minimum weight of bass for spawning to be five to six ounces. On the basis of the Iowa pond data such bass would be approximately nine inches in total length. On the average this size is reached sometime during the third summer of life and probably near the end of the growing season. The minimum spawning size is therefore probably reached too late for the spawning
<table>
<thead>
<tr>
<th>locality</th>
<th>Authority</th>
<th>No. of fish</th>
<th>calculated total lengths in inches at each annulus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pond No. 25</td>
<td>Present study</td>
<td>44</td>
<td>3.4 6.6 12.5 13.5</td>
</tr>
<tr>
<td>Red Haw Lake</td>
<td>Lewis, 1950</td>
<td>57</td>
<td>3.7 6.8 9.2 11.4 12.3 13.2 17.1 22.2</td>
</tr>
<tr>
<td>East Lake</td>
<td>Lewis, 1950</td>
<td>64</td>
<td>4.4 7.9 10.4 12.1 14.4 16.7 17.8 19.9</td>
</tr>
<tr>
<td>Ike Lake</td>
<td>Ruhr, 1952</td>
<td>71</td>
<td>3.0 7.0 10.2 13.2 16.4</td>
</tr>
<tr>
<td>Farm ponds</td>
<td>Present study</td>
<td>93</td>
<td>5.3 9.1 12.2 13.2 14.3</td>
</tr>
<tr>
<td>Ohio lakes</td>
<td>Roach and</td>
<td>500</td>
<td>3.4* 7.2 10.1 12.5 14.5 16.1 17.7 18.9</td>
</tr>
<tr>
<td>Wisconsin lakes</td>
<td>Bennett, 1937</td>
<td>618</td>
<td>3.3 7.4 10.5 12.5 14.0 15.1 16.3 17.4</td>
</tr>
<tr>
<td>Thompson and</td>
<td>Bennett, 1939</td>
<td>144</td>
<td>3.8 8.1 11.4 13.3 14.9 16.6 18.4 19.6</td>
</tr>
<tr>
<td>Illinois</td>
<td>Bennett, 1945</td>
<td>81</td>
<td>3.4 10.6 14.0 16.5 18.6</td>
</tr>
</tbody>
</table>

*Lengths at various annuli interpreted from graph of growth.
period that year, and such bass would first reproduce as three
year old fish (in their fourth year of life). Our data show that
in the newly stocked ponds, the bass customarily spawn as two year
old fish. In 17 newly stocked ponds where bass were known to have
survived and where inspections were made in subsequent years, success­
ful spawning occurred in each during the second spring following
stocking. These bass were all stocked as fingerlings in the fall.
Bennett (1948b) found bass from Fork Lake, Illinois, sexually mature
at two years of age. Dugan (1951), in six experimental farm ponds
in West Virginia, found bass reproducing the second summer after
stocking in three ponds, the year after stocking in one pond, and
reproducing for the first time during the third year after stocking
in two ponds. Both of the last-mentioned ponds had existing
populations of other species of fish at the time of stocking, so
that the delayed spawning may have been an end result of competition
for food and space.

The onset of spawning by largemouth black bass apparently follows
the spring rise in water temperatures to 70°F (Swingle, 1949).
Spawning periods reported for the bass include: April–June for
Alabama (Swingle and Smith, 1943); May for Fork Lake, Illinois
(Bennett, 1948p); prior to May 28–June 15 for Deep Lake, Michigan
(Carbine, 1939). Because spawning dates were never specifically
investigated for the Iowa ponds, little information is available other
than that the year's hatch of young bass was usually present in the
ponds by late June.
After the first reproduction of bass occurred in a pond, reproduction generally occurred each year thereafter, except where the fish were decimated by winterkill or other causes. Data on 17 ponds, for years following a season of successful spawning of both species stocked, show only three instances where bass did not spawn annually and for which there is no clear explanation. In Pond 18 both bass and bluegills reproduced in 1948 and in 1951, but the bass did not do so in the two intervening years, 1949 and 1950. In Pond 27 both species reproduced in 1947 and 1949, but the bass did not reproduce in 1948. Pond 25 showed a similar pattern, with bass reproducing in 1949 and 1951 but not in 1950. Bass populations in Iowa ponds are apparently more successful in spawning than are those in Indiana ponds, for which Krumholz (1951) reported successful spawning only one year in every two on the average.

B. Bluegill

The bluegill serves the role of forage fish in farm ponds. It grows to a larger size than many of the other sunfishes and spawns intermittently throughout the summer months, thereby providing a succession of food for the bass with which it is customarily stocked (Swingle and Smith, 1930).

Collections of bluegills were made from 19 ponds at the same time and in the same manner as the collections of bass. The data have been combined briefly to furnish a generalized picture of Iowa ponds followed by data from individual ponds.
1. Age and growth

a. Length-weight. The length-weight relationship was determined for 1435 bluegills varying in length from 3.5 inches to 8.6 inches. The lower size limit was chosen somewhat arbitrarily to reduce weighing errors with the balance used, and the upper limit denotes maximum size of the bluegills captured. The length-weight equation in logarithmic form for the bluegill is:

\[ \log W = -1.360 + 3.282 \log L \]

where \( W \) = the weight in hundredths of pounds
and \( L \) = the total length in inches.

As indicated by the formula the weight of bluegills increased somewhat more rapidly than the cube of the length. The means of the observed total lengths and weights are presented in Table 15, and the weights estimated by the above length-weight formula are also offered for comparison. On the average, bluegills reach a weight of one-fourth pound at a length of approximately 7.0 inches, and a weight of one-half pound at 8.5 inches. A weight of one-fourth pound corresponds to what Bennett, Thompson and Parr (1940) have defined as "desirable size" for bluegill, representing the minimum size for table use.

b. Condition factors. Condition factors or ponderal indices were computed for the 1435 bluegills over 3.5 inches and are presented in Table 15 in the form of means for the various size groups. As is to be expected from the length-weight formula, relative plumpness tends to increase with an increase in length. The
Table 15. Total Length, Weight, and Condition of Bluegills, 19 Farm Ponds, Marion County, Iowa, 1950 and 1951

<table>
<thead>
<tr>
<th>Mean total length inches</th>
<th>Number of fish</th>
<th>Mean weight lbs. x 100</th>
<th>Mean condition</th>
<th>Estimated weight lbs. x 100</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.7</td>
<td>238</td>
<td>3.28</td>
<td>66.2</td>
<td>3.20</td>
</tr>
<tr>
<td>4.2</td>
<td>198</td>
<td>4.89</td>
<td>65.7</td>
<td>4.85</td>
</tr>
<tr>
<td>4.7</td>
<td>217</td>
<td>6.88</td>
<td>65.8</td>
<td>7.02</td>
</tr>
<tr>
<td>5.2</td>
<td>219</td>
<td>9.49</td>
<td>68.4</td>
<td>9.78</td>
</tr>
<tr>
<td>5.7</td>
<td>229</td>
<td>13.40</td>
<td>71.5</td>
<td>13.22</td>
</tr>
<tr>
<td>6.2</td>
<td>192</td>
<td>17.16</td>
<td>74.5</td>
<td>17.42</td>
</tr>
<tr>
<td>6.7</td>
<td>87</td>
<td>22.51</td>
<td>75.6</td>
<td>22.47</td>
</tr>
<tr>
<td>7.2</td>
<td>50</td>
<td>28.19</td>
<td>76.6</td>
<td>28.46</td>
</tr>
<tr>
<td>7.9</td>
<td>45</td>
<td>36.63</td>
<td>78.0</td>
<td>36.59</td>
</tr>
<tr>
<td>8.2</td>
<td>22</td>
<td>42.25</td>
<td>78.7</td>
<td>43.61</td>
</tr>
<tr>
<td>8.6</td>
<td>4</td>
<td>53.90</td>
<td>86.2</td>
<td>50.99</td>
</tr>
</tbody>
</table>

Total 1435

Mean 69.7

\[ \log W = -1.360 + 3.282 \log L. \]
range for condition factors for individual bluegills is from a
low of 36.2 for a 4.0 inch fish from Pond 5 to a high of 104.5
for a 3.9 inch fish from Pond 18. The mean condition factor of
all of the bluegills is 69.7, which, on the basis of the standards
suggested by Bennett (1950), is intermediate between poor and
average plumpness. Bennett, in the publication cited above,
demonstrates that the average condition of a population of blue-
gills fluctuates annually, with a characteristic high level of
condition in May and a low one in November. To compare condition
factors for several populations it is therefore necessary, not
only that they be for similar length ranges, but that the collec­
tions of data be for similar seasons of the year. It is felt
that the populations listed in Table 16 were sampled at nearly
enough the same season that they can be compared.

c. Growth. Data on growth of bluegills in Marion County farm
ponds is based on the study of scales taken from 567 fish from
12 of the ponds during 1950 and 1951. Assessment of age and
calculation of total length for various years of growth was by
the methods outlined in the discussion of the largemouth black
bass. The ponds are separated into groups for presentation and
discussion of the data (Tables 17, 18 and 19).

The ponds grouped in Table 17 are those having a succession
of age classes of both bass and bluegills, and are judged to be
in balance according to the definition of Swingle (1950). The
ponds most productive of fishing are in this group, but also
Table 16. Comparison of Condition Factors for Bluegills from Various Midwestern Localities

<table>
<thead>
<tr>
<th>Authority</th>
<th>Locality</th>
<th>Range in total length inches</th>
<th>Range in subgroups</th>
<th>Mean C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beckman, 1948</td>
<td>Michigan lakes</td>
<td>1.4-10.0</td>
<td>56 - 75</td>
<td>--</td>
</tr>
<tr>
<td>Present study</td>
<td>Iowa, farm ponds</td>
<td>3.5-8.6</td>
<td>65.8-86.2</td>
<td>69.7</td>
</tr>
<tr>
<td>Lewis, 1950</td>
<td>Iowa, Red Haw Lake</td>
<td>2.2-10.6</td>
<td>--</td>
<td>70.4*</td>
</tr>
<tr>
<td>Lewis, 1950</td>
<td>Iowa, East Lake</td>
<td>2.5-8.5</td>
<td>--</td>
<td>69.4*</td>
</tr>
<tr>
<td>Ruhr, 1952</td>
<td>Iowa, Ike Lake</td>
<td>3.0-6.4</td>
<td>61.0-91.9</td>
<td>64.1</td>
</tr>
</tbody>
</table>

* Data converted from K(S.L.) to C(T.L.) by use of formula

\[
C = 36.1 \times r \times K_m
\]

where \( r \) = ratio of standard length to total length for the population concerned

and \( K_m \) = coefficient of condition in the metric system.
Table 17. Growth Summaries for Bluegills, Ponds with a History of Balanced Populations

<table>
<thead>
<tr>
<th>Pond number</th>
<th>Number of fish</th>
<th>Average calculated length at each annulus in inches</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>29</td>
<td>1.8</td>
</tr>
<tr>
<td>6 (1950)</td>
<td>51</td>
<td>1.4</td>
</tr>
<tr>
<td>6 (1951)</td>
<td>68</td>
<td>1.0</td>
</tr>
<tr>
<td>12</td>
<td>29</td>
<td>1.6</td>
</tr>
<tr>
<td>33</td>
<td>33</td>
<td>1.1</td>
</tr>
<tr>
<td>45 (1950)</td>
<td>48</td>
<td>3.4</td>
</tr>
<tr>
<td>45 (1951)</td>
<td>51</td>
<td>3.3</td>
</tr>
<tr>
<td>51</td>
<td>33</td>
<td>1.6</td>
</tr>
<tr>
<td>57</td>
<td>32</td>
<td>1.0</td>
</tr>
</tbody>
</table>

Total: 374

Means: 1.7  4.1  6.1  7.0
included are two where fishing pressure was almost non-existent. Growth in this group of ponds was generally good, with total lengths at successive annuli of 1.7, 4.1, 6.1 and 7.0 inches. Bluegills in all the ponds were relatively young; only Pond 6 contained any bluegills 4 years of age or older.

Pond 2, stocked 5 and 6 years prior to sampling, was treated with rotenone, and all fish other than young of the current year were collected. White crappies and black bullheads were present in addition to bass and bluegills, and the crappies were apparently more nearly dominant than were the bluegills. The presence of brush and rock "shelters" in the pond may have favored the crappies, and the competition of the crappies and bullheads combined held bluegills growth to less than the mean for other ponds in Table 17. Bluegills 5-5 inches or more long made up 80 percent of all the bluegills over one year of age.

Pond 6, stocked in 1941, was sampled in both 1950 and 1951, by seining and angling. It contained bass, bluegills, white crappies and black bullheads. White bass appeared to dominate the pond, the crappies were numerous and successful in reproducing annually. By size and weight they appeared more successful than the bluegills, although the bluegills were more abundant. Rates of growth of the bluegills for the two years of collection varied, with the 1950 collection showing the more rapid growth. Bluegills of age classes I and II predominated in numbers both years, the
samples showing few three-year-old fish. Bluegills 5.5 inches long and longer made up 14 to 17 percent of all bluegills in the samples. Population estimates for bluegills varied from approximately 1500 in 1950 to 1500 to 2500 fish in 1951.

Pond 12 contained bass, bluegills and golden shiners, with the golden shiners few in number and of small size and probably of a single recent age class. Probably the bass consumed the annual production of young golden shiners each year. Fishing for bluegills was uncontrolled at this pond and heavier than that at almost any other pond. Bluegills after their first year grew at a more rapid rate than the means for all ponds in the table. Fifty percent of all the bluegills over one year of age were 5.5 inches or longer.

Pond 33 contained bass, bluegills and black bullheads. The bullheads appeared more numerous than the bluegills and all of them were more than seven inches long. Young bullheads produced in 1950 had vanished by 1951 and were presumed eaten by the bass. The water in the pond was always roily with mud attributed to the bullheads. The original stocking of bass displayed poor growth, being only 10 to 12 inches long at four years of age. The growth rate of bluegills was approximately that of the means for Table 17, and only 11 percent of the bluegills were 5.5 inches long or better.

The bluegills in Pond 45 showed a more rapid growth rate than those in any other pond. Total lengths at various annuli
calculated from the 1950 collection of bluegills were 3.4 inches, 6.2 inches and 7.3 inches for the first three years of life. The growth rate determined from the 1951 collection was similarly rapid. For several years prior to 1946 this pond reportedly produced bluegills up to 11 inches long, but the present collections included no bluegills over 8.5 inches. Growth of bass was also rapid, with fish of Age Group III being 13.5 to 15.0 inches long. Populations of both bass and bluegills were heavy, with estimates of 800 to 1200 fish for the 0.3 acre pond. Bluegills over 5.5 inches made up 23 percent and 54 percent of the 1950 and 1951 collections respectively.

Pond 51 is included in the table on balanced populations on the basis of successful reproduction of both bass and bluegills, although one year was missing from the sequence for both species. The pond was in its fourth summer when collections of fish were made, and the original stocking of bass and bluegills had reached 15.4 inches and 6.7 inches total length respectively. Growth of bluegills generally was near the mean for all the balanced populations. Fish over 5.5 inches long made up 43 percent of the bluegills captured in 1950.

Pond 57 was continuously muddy with fine suspended clay. Populations of both bass and bluegills seemed low, and the rate of growth for bluegills was somewhat less than the mean for all balanced ponds. Forty-seven percent of the bluegills were 5.5
inches or more long.

The ponds grouped in Table 18 are those having a history of interrupted sequence of bass and bluegill reproduction, although both species may have been present in the pond as adults or sub-adults. The fish populations in these ponds are judged to have not been satisfactory for sustained production of harvestable fish. None of these ponds were fished to any extent, although one of them contained good numbers of harvestable size bluegills. The rate of growth of bluegills in these ponds was noticeably slower than in the balanced ponds. The means for total length at successive annuli are 1.2, 3.0, 5.0 and 5.8 inches. Four-year-old bluegills were present in fair numbers in two of the four ponds listed in the table.

Table 18. Growth Summaries for Bluegills, Ponds with a History of Unbalanced Populations

<table>
<thead>
<tr>
<th>Pond number</th>
<th>Number of fish</th>
<th>Average calculated length at each annulus in inches</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>14</td>
<td>46</td>
<td>0.9</td>
</tr>
<tr>
<td>18</td>
<td>42</td>
<td>1.1</td>
</tr>
<tr>
<td>30</td>
<td>43</td>
<td>1.7</td>
</tr>
<tr>
<td>43</td>
<td>22</td>
<td>1.5</td>
</tr>
<tr>
<td>Total</td>
<td>153</td>
<td></td>
</tr>
<tr>
<td>Means</td>
<td></td>
<td>1.2</td>
</tr>
</tbody>
</table>
In Pond 14 successful reproduction of bass and bluegills occurred in the same year only once in the first seven years after stocking. Additional bass were stocked two years after the first stocking and these reproduced for the first time in their fourth summer. Two of the 15 bass in the second stocking were removed in 1949 and may have left few bass to serve as predators, as bullfrog tadpoles were abundant in the pond the following year. Bluegills reproduced four years in the last five of record, and the oldest fish had attained a length of only 5.4 inches by the end of their fourth year of life. The 1950 bluegill population over 3.5 inches long was estimated at 886 fish for the half-acre pond. Black bullheads were present in the pond but seemed few in number and, so far as is known, did not reproduce in either 1950 or 1951.

Bluegills in Pond 18 showed the best growth of any grouped in Table 18, with the original stocking of bluegills reaching 6.5 inches at the end of their fourth year. The young bluegills produced the summer following stocking also showed relatively good growth, while bluegills of the next two year-classes showed poor growth. The water was constantly muddy with suspended fine clay and was relatively cold in temperature (68°F. at one meter depth in mid-day on August 27, 1951). Bass of the original stocking reproduced the second summer, and then skipped two years before producing young again. The bluegills reproduced every year, 1946-1951. In 1950 47 percent of the bluegills were 5.5 inches long or longer, all of them members of the
year-classes of the original stocking and the year following. In 1950 the population of bluegills 3.5 inches and longer was estimated at 123 fish. The first young bass produced in the pond were seven to nine inches long in their third summer, indicating rather poor growth.

Data for Pond 30 indicate that winterkill must have occurred with some regularity. Three years after the original stocking of bass, bluegills and bullheads a second stocking of bass was made, but was apparently not entirely needed to populate the pond, since a very heavy crop of young bass was produced the following year. The fourth winter after the second stocking winterkill occurred and a third stocking was made to replenish the bass. Bluegills reproduced successfully in all but one of the five years of record. Bullheads were abundant in 1949 and 1950 and a total of 80 pounds were removed by seine in those two years in attempts to bring the population under control. Bluegills of the 1947 year class predominated in the 1950 collection of fish, with individuals 5.5 inches or longer making up 41 percent of all those collected. Growth was rapid for the first two years of life and slow for the third, an indication that probably two growing seasons were necessary to bring the depleted population to carrying capacity following winterkill. Population estimates were, in 1947, 682 bluegills and 253 bullheads and, in 1950, 81 to 172 bluegills and 49 to 78 bullheads.

The data for Pond 43 present a somewhat special case in that the collection of fish in 1950 revealed only one fish more than one year
old. No bluegill was over 5.5 inches in total length although the pond had been stocked for four years. The pond was continually muddy with fine clay, and black bullheads outnumbered the bluegills in the 1949 seining at a ratio of eight to one. The original stocking of bass reproduced for the first time as three year old fish.

Growth data for Pond 25 are listed separately in Table 19 as an example of bluegill growth in a pond over-populated with bass. In 1947 the pond was judged as becoming over-populated with bass, and in 1949 a large hatch of bass occurred that dominated the pond for that and the following two years. Bluegills reproduced successfully in small numbers each year except 1950. They probably were successful the following year, 1951, only because winterkill had reduced the number of bass in the pond, lessening the pressure by predators. Seining showed few bluegills in the pond in any one year and such bluegills were usually large in size. Growth was rapid, particularly in the last two years of study, with the length means at successive annuli being 1.5, 4.4, 6.1 and 7.1 inches. The largest bluegill collected in any of the ponds studied, 8.6 inches, was from this pond.

Growth rates for bluegills in the present study rank well by comparison with other bodies of water (Table 20). Growth in the balanced ponds and in Pond 25 is equal to that of other Iowa impoundments and is generally superior to that of the other midwestern lakes listed.
Table 19. Calculated and Measured Total Lengths of 40 Bluegills from Pond 25, Marion County, Iowa, 1950 and 1951

<table>
<thead>
<tr>
<th>Age class</th>
<th>Number of fish</th>
<th>Average calculated length in inches at annulus</th>
<th>Length at capture</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>6</td>
<td>3.2</td>
<td>5.1</td>
</tr>
<tr>
<td>II</td>
<td>18</td>
<td>1.3</td>
<td>6.4</td>
</tr>
<tr>
<td>III</td>
<td>6</td>
<td>1.2</td>
<td>3.9</td>
</tr>
<tr>
<td>IV</td>
<td>10</td>
<td>1.2</td>
<td>3.9</td>
</tr>
</tbody>
</table>

| Mean total length, inches | 1.5 | 4.4 | 6.1 | 7.1 |
| Annual increments         | 1.5 | 4.0 | 2.1 | 1.4 |
| Sum of increments         | 1.5 | 5.5 | 7.3 | 8.7 |
Table 20. Comparison of Average Growth for Bluegills from Various Localities

<table>
<thead>
<tr>
<th>Locality</th>
<th>Authority</th>
<th>Number of fish</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I. Iowa impoundments</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unbalanced ponds</td>
<td>Present study</td>
<td>153</td>
<td>1.2</td>
<td>3.0</td>
<td>5.0</td>
<td>5.8</td>
<td></td>
</tr>
<tr>
<td>Balanced ponds</td>
<td>Present study</td>
<td>374</td>
<td>1.7</td>
<td>4.1</td>
<td>6.1</td>
<td>7.0</td>
<td></td>
</tr>
<tr>
<td>Pond 25</td>
<td>Present study</td>
<td>40</td>
<td>1.5</td>
<td>4.4</td>
<td>6.1</td>
<td>7.1</td>
<td></td>
</tr>
<tr>
<td>Ike Lake</td>
<td>Ruhr, 1952</td>
<td>308</td>
<td>1.4</td>
<td>3.2</td>
<td>4.2</td>
<td>6.4</td>
<td></td>
</tr>
<tr>
<td>Red Haw Lake</td>
<td>Lewis, 1950</td>
<td>133</td>
<td>1.4</td>
<td>3.4</td>
<td>6.1</td>
<td>7.2</td>
<td>8.1</td>
</tr>
<tr>
<td>East Lake</td>
<td>Lewis, 1950</td>
<td>145</td>
<td>1.7</td>
<td>3.6</td>
<td>5.6</td>
<td>7.0</td>
<td>7.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>II. Other midwestern lakes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Buckeye Lake, Ohio</td>
<td>Morgan, 1951</td>
<td>332</td>
<td>1.6</td>
<td>2.9</td>
<td>4.1</td>
<td>5.2</td>
<td>6.0</td>
</tr>
<tr>
<td>Clearwater Lake, Missouri</td>
<td></td>
<td>830</td>
<td>2.5</td>
<td>4.2</td>
<td>5.6</td>
<td>6.6</td>
<td></td>
</tr>
<tr>
<td>Ohio Lakes</td>
<td>Boesch and Evans, 1947</td>
<td>-</td>
<td>1.7</td>
<td>3.6</td>
<td>5.1</td>
<td>5.9</td>
<td>6.9</td>
</tr>
<tr>
<td>Crab Orchard Lake, Illinois (for year 1951)</td>
<td>Whitacre, 1952</td>
<td>3.1</td>
<td>4.6</td>
<td>5.6</td>
<td>6.2</td>
<td>7.0</td>
<td></td>
</tr>
</tbody>
</table>

*Lengths at various annuli interpreted from graph of growth.
2. Reproduction

Bluegills have been reported as spawning at one year of age if, at that time, they weighed one-half ounce or more (Swingle and Smith, 1943). Bluegills of that weight in Iowa farm ponds would be approximately 3.5 inches in total length. So far as is known this minimum size was reached in all newly stocked ponds the summer following stocking and bluegill reproduction occurred. The minimum size was not normally reached by yearling bluegills in other ponds where the stocking was several years old.

The time of spawning by bluegills has been reported as ranging from May to August for midwestern lakes (Bennett, 1948 and Morgan, 1951). In the Iowa ponds young bluegills could usually be collected with a minnow seine by late June or early July. In four instances, however (Ponds 6, 14, 30 and 43), young could not be located in early summer but were found readily by an August inspection of fish of a corresponding age class turned up in collections the following year. Water temperatures less than 80°F (Swingle, 1949) or overcrowding (Swingle and Smith, 1943) may be responsible for late spawning of bluegills. The latest known hatching of bluegills was in Pond 43 in 1951, where abundant bluegills three-fourths inches long were found October 11th. On the basis of development stages given by Morgan (1951) these bluegills would be at least four weeks old, with a probable hatching date of September 13 or slightly earlier. Of course, it is possible that growth for the
season had already ceased or slowed down considerably, in which case, the hatch was somewhat earlier.

After bluegills reproduced for the first time in a pond they generally reproduced successfully each year, except where prevented by winterkill or other cause. In Pond 25 the failure of bluegill reproduction was probably due to the heavy population of bass. Failure in Pond 30 for the year 1948 and Pond 51 for 1951 followed possible winterkill conditions. Cause of the failure in Pond 6 for 1951 is unknown but may possibly have been caused by human interference as an intensive trapping program using wire traps was carried on throughout the month of August. As implied under the discussion on delayed spawning, and as suggested by Ball and Tait (1952), low temperatures may also be involved in failures to spawn. In some northern waters (Ball, 1952; Krumholz, 1951) bluegills may not spawn at all in certain years.

C. White Crappie

In farm fish ponds the white crappie has a role intermediate between a predator and a forage fish (Swingle and Smith, 1940). Bennett (1943) regards the white crappie as well suited to artificial lakes, where it reproduces very successfully, but where its numbers must be reduced at intervals to prevent stunting.
Records show that white crappies were part of the original stocking in seven of the 60 ponds. When first inspected during the present study, two of these ponds no longer contained any crappies and one additional pond contained crappies apparently stocked supplementarily. One of these, Pond 23, was no longer suitable for fish and another, Pond 7, contained such an unbalanced population that it was deemed valueless for study and was never again visited. All four of the remaining ponds contained reproducing populations of crappies, and Ponds 2 and 6, where collections were made, showed crappies reproducing almost annually.

1. Age and growth

a. Length-weight and condition. The length-weight relationships for crappies taken from Ponds 2 and 6 in 1950 were calculated separately and the following formulae in logarithmic form obtained:

(1) Pond 2: $\log W = -1.458 + 3.208 \log L$

(2) Pond 6: $\log W = -1.528 + 3.177 \log L$

where $W$ = the weight in hundredths of pounds and $L$ = the total length in inches.

As indicated by the formulae, the weight of white crappies in both ponds increased more rapidly than the cube of the length. Although the two regression coefficients (3.208 and 3.177) seem closely similar, tabulation of the means of the observed lengths, weights and estimated weights shows that the Pond 2 crappies weigh noticeably more for their length than do Pond 6 crappies (Table 21). This is born out by the calculated condition factors, $C$, also listed in
Table 21. Total Length, Weight, and Condition of White Crappies, Pond 2 and Pond 6, Marion County, Iowa, 1950

<table>
<thead>
<tr>
<th>Mean total length inches</th>
<th>Number of fish</th>
<th>Mean weight lbs. x 100</th>
<th>Mean condition C</th>
<th>Estimated* weight lbs. x 100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pond 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.8</td>
<td>2</td>
<td>2.3</td>
<td>41.9</td>
<td>2.5</td>
</tr>
<tr>
<td>4.2</td>
<td>6</td>
<td>3.8</td>
<td>51.3</td>
<td>3.5</td>
</tr>
<tr>
<td>4.7</td>
<td>18</td>
<td>5.1</td>
<td>49.1</td>
<td>5.0</td>
</tr>
<tr>
<td>5.1</td>
<td>11</td>
<td>6.5</td>
<td>48.9</td>
<td>6.5</td>
</tr>
<tr>
<td>7.2</td>
<td>2</td>
<td>19.3</td>
<td>51.7</td>
<td>19.6</td>
</tr>
<tr>
<td>7.8</td>
<td>2</td>
<td>25.1</td>
<td>53.0</td>
<td>25.3</td>
</tr>
<tr>
<td>8.2</td>
<td>4</td>
<td>30.1</td>
<td>54.5</td>
<td>29.8</td>
</tr>
<tr>
<td>8.6</td>
<td>3</td>
<td>34.0</td>
<td>53.4</td>
<td>34.5</td>
</tr>
<tr>
<td>9.1</td>
<td>1</td>
<td>40.3</td>
<td>53.6</td>
<td>41.5</td>
</tr>
<tr>
<td>10.4</td>
<td>1</td>
<td>78.2</td>
<td>69.5</td>
<td>63.8</td>
</tr>
<tr>
<td>10.6</td>
<td>1</td>
<td>60.8</td>
<td>51.1</td>
<td>67.6</td>
</tr>
<tr>
<td>11.2</td>
<td>1</td>
<td>75.6</td>
<td>53.8</td>
<td>80.8</td>
</tr>
<tr>
<td>Pond 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.8</td>
<td>1</td>
<td>7.9</td>
<td>40.5</td>
<td>7.9</td>
</tr>
<tr>
<td>6.9</td>
<td>2</td>
<td>13.1</td>
<td>39.8</td>
<td>13.7</td>
</tr>
<tr>
<td>7.3</td>
<td>39</td>
<td>17.0</td>
<td>43.7</td>
<td>16.4</td>
</tr>
<tr>
<td>7.7</td>
<td>59</td>
<td>20.3</td>
<td>44.5</td>
<td>19.4</td>
</tr>
<tr>
<td>8.1</td>
<td>4</td>
<td>21.8</td>
<td>41.0</td>
<td>22.7</td>
</tr>
</tbody>
</table>

*Pond 2: \( \log W = -1.153 + 3.208 \log L \)

Pond 6: \( \log L = -1.528 + 3.177 \log L \)
Table 21, which indicate greater relative plumpness for the Pond 2 fish. Since the collections of crappies from both ponds were made in early August of the same year (1950) there is little likelihood that seasonal fluctuations in condition could be responsible for the observed differences, as was demonstrated for coefficient of condition, C

The crappies from the two ponds are intermediate in plumpness when compared (Table 22) with crappies from a northern Iowa natural lake (Erickson, 1952) and two southern Iowa impounded lakes (Lewis, 1950).

Table 22. Comparison of Condition Factors for White Crappies from Various Iowa Waters

<table>
<thead>
<tr>
<th>Authority</th>
<th>Locality</th>
<th>Number of fish</th>
<th>Mean C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erickson, 1952</td>
<td>Clear Lake</td>
<td>169</td>
<td>55.4*</td>
</tr>
<tr>
<td>Present Study</td>
<td>Pond 2</td>
<td>41</td>
<td>49.9</td>
</tr>
<tr>
<td>Present Study</td>
<td>Pond 6</td>
<td>105</td>
<td>43.2</td>
</tr>
<tr>
<td>Lewis, 1950</td>
<td>East Lake</td>
<td>90</td>
<td>42.9*</td>
</tr>
<tr>
<td>Lewis, 1950</td>
<td>Red Haw Lake</td>
<td>29</td>
<td>42.2*</td>
</tr>
</tbody>
</table>

*Data converted from K(S.L.) to C(T.L.) by use of formula

\[ C = 36.1 \times \frac{3}{r} \times K_m \]

where \( r \) = ratio of standard length to total length for the population concerned, and \( K_m \) = coefficient of condition in the metric system.

b. Growth. The growth of crappies in Pond 2 and Pond 6 ranks relatively poor when compared with the rates of growth for other midwestern waters (Table 23). It apparently takes about three growing
Table 23. Comparison of Average Growth for White Crappies from Various Midwestern Localities

<table>
<thead>
<tr>
<th>Authority</th>
<th>Locality</th>
<th>Number of fish</th>
<th>Calculated total length in inches at each annulus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Present study</td>
<td>Pond 6</td>
<td>45</td>
<td>2.3 5.7 7.5 9.1 4.1</td>
</tr>
<tr>
<td>Present study</td>
<td>Pond 2</td>
<td>50</td>
<td>2.0 5.1 6.6 7.8 9.6</td>
</tr>
<tr>
<td>Lewis, 1950</td>
<td>East Lake, Iowa</td>
<td>84</td>
<td>2.1 5.3 6.7 7.7 8.4 9.1</td>
</tr>
<tr>
<td>Erickson, 1952</td>
<td>Clear Lake, Iowa</td>
<td>44</td>
<td>2.0 5.1 7.4</td>
</tr>
<tr>
<td>Roach and Evans, 1948a</td>
<td>53 Ohio lakes 1200</td>
<td>2.6 5.5 7.7 9.1 10.4 11.7</td>
<td></td>
</tr>
<tr>
<td>Lewis, 1950</td>
<td>Red Haw Lake, Iowa</td>
<td>28</td>
<td>3.1 7.6 8.4 9.9 11.2 12.1</td>
</tr>
<tr>
<td>Ricker and Lagler, 1942</td>
<td>Foots Pond, Indiana</td>
<td>230</td>
<td>2.3 5.8 8.6 10.2 11.5</td>
</tr>
<tr>
<td>Hansen, 1951</td>
<td>Lake Decatur, Illinois</td>
<td>962</td>
<td>- 7.3* 9.1 10.5 10.6 12.2</td>
</tr>
</tbody>
</table>

*Observed total lengths at end of growing season.
seasons to produce a six-inch crappie, or one that would be a desirable or harvestable size.

2. Reproduction

White crappies apparently stocked as yearlings from a nearby stream reproduced the year following in Pond 2. In Pond 6 where they were stocked as fingerlings, crappies first reproduced as two year olds. Spawning occurred every year in Pond 2 but was intermittent in Pond 6, with no visible reproduction in 1948 and 1949.

D. Black Bullhead

The bullhead has long been used in stocking ponds and artificial lakes because it reproduces successfully and is easily caught by inexperienced fishermen with simple tackle. Its feeding habits on muddy bottoms have brought it general accusations of being the cause of roiliness in the waters of shallow lakes and ponds. Furthermore, bullheads usually become overcrowded and stunted when bass predation is not adequate.

1. Age and growth

a. Length-weight and condition. Black bullheads occurred in fair numbers in some ponds in association with bass and bluegills. Length-weight data for 2+ bullheads from seven such ponds combined are presented in Table 24. Minimum desirable size for bullheads is...
Table 24. Total Length, Weight, and Condition of Black Bullheads, Seven Farm Ponds, Marion County, Iowa, 1950 and 1951

<table>
<thead>
<tr>
<th>Mean total length inches</th>
<th>Number of fish</th>
<th>Mean weight lbs. x 100</th>
<th>Mean condition %</th>
<th>Estimated total length lbs. x 100</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.5</td>
<td>1</td>
<td>2.4</td>
<td>56.0</td>
<td>2.1</td>
</tr>
<tr>
<td>4.3</td>
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<td>3.9</td>
<td>49.8</td>
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<td>4.5</td>
<td>3</td>
<td>4.1</td>
<td>45.3</td>
<td>4.4</td>
</tr>
<tr>
<td>5.7</td>
<td>2</td>
<td>8.9</td>
<td>49.1</td>
<td>9.1</td>
</tr>
<tr>
<td>6.3</td>
<td>13</td>
<td>11.5</td>
<td>43.8</td>
<td>12.4</td>
</tr>
<tr>
<td>6.7</td>
<td>47</td>
<td>13.6</td>
<td>44.2</td>
<td>15.0</td>
</tr>
<tr>
<td>7.3</td>
<td>51</td>
<td>18.1</td>
<td>47.6</td>
<td>19.4</td>
</tr>
<tr>
<td>7.7</td>
<td>78</td>
<td>21.7</td>
<td>47.7</td>
<td>22.9</td>
</tr>
<tr>
<td>8.1</td>
<td>32</td>
<td>26.8</td>
<td>49.7</td>
<td>26.7</td>
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<td>8.6</td>
<td>9</td>
<td>32.6</td>
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<tr>
<td>9.0</td>
<td>3</td>
<td>39.8</td>
<td>53.9</td>
<td>36.9</td>
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<tr>
<td>9.6</td>
<td>2</td>
<td>47.0</td>
<td>53.0</td>
<td>45.0</td>
</tr>
<tr>
<td>10.4</td>
<td>1</td>
<td>62.6</td>
<td>55.7</td>
<td>57.5</td>
</tr>
</tbody>
</table>

Total 244

Mean

\[ \log W = -1.3518 + 3.0596 \log L \]
about six inches, at which time they weigh approximately one-tenth pound. The condition factors, C, are also listed in the table, and show a general tendency toward increase in value with an increase in length of the fish.

b. Growth. No attempt was made to determine age of the bullheads by analysis of the growth rings on the vertebrae as done by Lewis (1949) for the bullhead or on the spines as done by Sneed (1950). Size classes of bullheads present in any one pond normally covered such a short range that there seemed to be only a single age class present, and therefore approximate ages of the fish could not be secured from length frequencies. In Pond 27 after a severe winterkill the winter of 1949-1950 eliminated most of the other fish and bullheads were able to spawn successfully for the first time in several years. By late June of the following year these fish were all approximately five inches long.

2. Reproduction

Data are lacking on the first appearance of bullhead fry in the ponds. Pond inspections made in the first two weeks of July encountered them if reproduction was successful at all that year. The young were, as far as is known, still in the school or pond at that time.
E. Population Estimates

Population estimates by the marking and recovery technique were obtained for 14 of the 60 study ponds. The formula of choice for these estimates was that of Schumacher and Eschmeyer (1943), but use was also made of the Schnabel (1938) and Petersen formulae. The formula used for each estimate is indicated in the tables (Tables 25-28). Estimates were converted to pounds by multiplying numbers of fish by the mean weight of all individuals of that species over 3.5 inches total length from that particular pond. Except where indicated otherwise, all recoveries were made with seines.

Ponds that were rated as being successful gave estimates of bluegills that were generally in the range of 100 to 400 pounds per acre (Table 25). Low estimates for two of the ponds were explainable. Pond 2, for which recoveries of marked fish were made by rotenone treatment, contained not only the 46 to 47 pounds of bluegills but also 58 to 60 pounds of white crappies, which brings the weight of forage fish in this pond within the range quoted for all successful ponds. Pond 18, with the low estimated weight of 41 pounds of bluegills per acre was continuously muddied with fine suspended clay and was thought to be very low in fertility. It was in balance, however, with reproducing populations of both bass and bluegills. Marked variations between estimates for any one pond (Ponds 6, 25 and 51) are thought to be
Table 25. Population Estimates, Bluegills
Successful Farm Ponds, 1950 and 1951

<table>
<thead>
<tr>
<th>Pond number</th>
<th>Date</th>
<th>Type of estimate</th>
<th>Bluegills used*</th>
<th>Standard error of estimate, per acre.</th>
<th>Bluegills per acre.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>8/10/50</td>
<td>P</td>
<td>350</td>
<td></td>
<td>46</td>
</tr>
<tr>
<td></td>
<td>8/10/50</td>
<td>Pr</td>
<td>355</td>
<td></td>
<td>47</td>
</tr>
<tr>
<td>6</td>
<td>7/15/50</td>
<td>Sch</td>
<td>2166</td>
<td>64</td>
<td>184</td>
</tr>
<tr>
<td></td>
<td>8/8/50</td>
<td>Sch</td>
<td>2010</td>
<td>41</td>
<td>171</td>
</tr>
<tr>
<td></td>
<td>8/3/51</td>
<td>P</td>
<td>1199</td>
<td></td>
<td>88</td>
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<td>8/21/51</td>
<td>P</td>
<td>2430</td>
<td></td>
<td>177</td>
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<td></td>
<td>8/24/51</td>
<td>P</td>
<td>3693</td>
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<td>270</td>
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<td>2740</td>
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<tr>
<td>12</td>
<td>7/14/50</td>
<td>Sch</td>
<td>1310</td>
<td>3</td>
<td>236</td>
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<tr>
<td>14</td>
<td>6/14/50</td>
<td>Sch</td>
<td>1774</td>
<td>7</td>
<td>104</td>
</tr>
<tr>
<td>18</td>
<td>6/17/50</td>
<td>Sch</td>
<td>307</td>
<td>7</td>
<td>41</td>
</tr>
<tr>
<td>25</td>
<td>6/16/50</td>
<td>Sch</td>
<td>328</td>
<td>4</td>
<td>104</td>
</tr>
<tr>
<td></td>
<td>7/22/50</td>
<td>P</td>
<td>110</td>
<td></td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>8/16/50</td>
<td>P</td>
<td>28</td>
<td></td>
<td>9</td>
</tr>
<tr>
<td>44</td>
<td>8/51</td>
<td>Snab</td>
<td>4505</td>
<td>29</td>
<td>441</td>
</tr>
<tr>
<td>45</td>
<td>7/13/51</td>
<td>Sch</td>
<td>2666</td>
<td>93</td>
<td>235</td>
</tr>
<tr>
<td>51</td>
<td>6/15/50</td>
<td>Sch</td>
<td>1091</td>
<td>20</td>
<td>142</td>
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<tr>
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<td>8/19/50</td>
<td>P</td>
<td>5036</td>
<td></td>
<td>655</td>
</tr>
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<td></td>
<td>8/19/50</td>
<td>Ps</td>
<td>1115</td>
<td></td>
<td>145</td>
</tr>
<tr>
<td>60</td>
<td>7/12/51</td>
<td>Sch</td>
<td>3545</td>
<td>98</td>
<td>422</td>
</tr>
</tbody>
</table>

*Types of estimate are as follows:
Sch = Schumacher and Eachmeyer
Snab = Schnabel, data by trapping
P = simple Petersen
Ps = Petersen, based on size groups
Pa = Petersen, data by angling
Pt = Petersen, data by trapping
Pr = Petersen, data by rotenone treatment.
Table 26. Population Estimates, Bluegills
Unsuccessful Farm Ponds, 1950 and 1951

<table>
<thead>
<tr>
<th>Pond number</th>
<th>Date</th>
<th>Type of estimate used</th>
<th>Bluegills per acre, number</th>
<th>Standard error of estimate, percent</th>
<th>Bluegills per acre, pounds</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>8/11/50</td>
<td>Sch</td>
<td>2220</td>
<td>25</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td>8/17/50</td>
<td>P</td>
<td>1863</td>
<td></td>
<td>63</td>
</tr>
<tr>
<td>30</td>
<td>5/28/50</td>
<td>Sch</td>
<td>390</td>
<td>14</td>
<td>52</td>
</tr>
<tr>
<td></td>
<td>7/12/50</td>
<td>Sch</td>
<td>573</td>
<td>6</td>
<td>77</td>
</tr>
<tr>
<td>37</td>
<td>8/3/51</td>
<td>Sch</td>
<td>167</td>
<td>34</td>
<td>32</td>
</tr>
<tr>
<td>46</td>
<td>7/21/50</td>
<td>P</td>
<td>710</td>
<td>50</td>
<td>53</td>
</tr>
<tr>
<td></td>
<td>7/21/50</td>
<td>P_s</td>
<td>740</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Types of estimate are as follows:
Sch = Schumacher and Eschmeyer
P = simple Petersen
P_s = Petersen, based on size groups
P_r = Petersen, data by rotenone treatment.
due largely to sampling error.

Ponds that were rated as unsuccessful gave estimates of bluegills considerably below those of the successful ponds (Table 26). Here poundages ranged from 30 to 75 pounds per acre.

Population estimates for bass were difficult to obtain. The seine was not an effective device for taking bass, and bass once marked were not often recaptured. Pond 46, a small tenth-acre pond, offered evidence of the low efficiency of seines in capturing bass. Two large bass were first captured and marked. Two days later only one of these was recaptured in three seine hauls, each of which covered 80 to 90 percent of the pond. Estimates are available for bass in only three ponds (Table 27), one of which contained large numbers of yearling bass.

Swingle (1950) offers a method of determining population balance in ponds from the ratio of the weight of all forage fish (F) to the weight of all piscivorous (carnivorous) fish (C). All sizes of fish including young-of-year are included in his computations. While the estimates for Iowa ponds are based entirely on fish 3.5 inches and over in total length, F/C ratios based on these estimates are probably only slightly lower than they would be if the weight of the smaller fish were known. Appropriate F/C ratios have been determined for the three ponds for which the bass were estimated. Pond 12, with 236 pounds of bluegills and 18 pounds of bass has an F/C ratio of 13, which classifies it as overcrowded with bluegills. Inspection of the
Table 27. Population Estimates, Bass, Successful Farm Ponds, 1950

<table>
<thead>
<tr>
<th>Pond number</th>
<th>Date</th>
<th>Type of estimate used</th>
<th>Bass per acre, number</th>
<th>Standard error of estimate, percent</th>
<th>Bass per acre, pounds</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>7/14/50</td>
<td>Sch</td>
<td>77</td>
<td>6</td>
<td>18</td>
</tr>
<tr>
<td>25</td>
<td>6/16/50</td>
<td>Sch</td>
<td>821</td>
<td>33</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>7/22/50</td>
<td>Sch</td>
<td>697</td>
<td>24</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td>8/16/50</td>
<td>P</td>
<td>983</td>
<td></td>
<td>96</td>
</tr>
<tr>
<td>51</td>
<td>6/15/50</td>
<td>Sch</td>
<td>70</td>
<td>61</td>
<td>41</td>
</tr>
</tbody>
</table>

*Types of estimate are as follows:
Sch = Schumacher and Eschmeyer
P = simple Petersen.
age and growth data for this pond reveal four year classes of bass ranging from 4.5 to 15.0 inches, and three year classes of bluegills, 50 percent of the last species being six inches or more long. The low rate of recapture of bass is thought partly responsible for the high $F/O$ ratio. This pond offered good fishing and was listed as highly successful.

The $F/O$ ratio for Pond 25 ranged from 1.3 to 0.1 according to the different estimates of weights. Under Swingle this pond would be classified as seriously overcrowded with bass. The numerous yearling bass in this pond ranged from 3.7 inches to 6.0 inches total length, and the lower sizes may have been serving as forage fish to some extent. The bluegills were present in four age classes and in sizes from 3.5 to 8.6 inches.

The last pond for which there is an estimate of bass showed an $F/O$ ratio of 3.5, which is well within Swingle's range of balanced populations.

With a single exception (Pond 51) numbers of bullheads adequate for population estimates were in ponds containing noticeably low populations of bass. Pond 51 was a successful pond with a good balance of bass and bluegills, and also contained bullheads estimated at 23 individuals weighing two pounds. The high poundages of bullheads for Ponds 16 and 41 (Table 28), as proven by pick-up following rotenone treatment, are characteristic of species having short food chains (Thompson, 1941).
Table 28. Population Estimates, Black Bullheads
Unsuccessful Farm Ponds, 1949 and 1950

<table>
<thead>
<tr>
<th>Pond number</th>
<th>Date</th>
<th>Type of estimate used</th>
<th>Bullheads per acre, number</th>
<th>Standard error of estimate, percent</th>
<th>Bullheads per acre, pounds</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>8/11/50 Sch</td>
<td>378</td>
<td>87</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td></td>
<td>8/11/50 P</td>
<td>10638</td>
<td></td>
<td>351</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>8/16/49 Sch</td>
<td>5436</td>
<td>38</td>
<td>323</td>
<td></td>
</tr>
<tr>
<td></td>
<td>8/18/49 Pick-up**</td>
<td>11751</td>
<td></td>
<td>653</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>5/28/50 Sch</td>
<td>167</td>
<td>58</td>
<td>38</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7/11/50 Sch</td>
<td>203</td>
<td>15</td>
<td>47</td>
<td></td>
</tr>
<tr>
<td>41</td>
<td>8/16/49 Sch</td>
<td>5370</td>
<td>7</td>
<td>275</td>
<td></td>
</tr>
<tr>
<td></td>
<td>8/16/49 P</td>
<td>5603</td>
<td></td>
<td>287</td>
<td></td>
</tr>
<tr>
<td></td>
<td>8/17/49 Sch</td>
<td>1625</td>
<td>9</td>
<td>83</td>
<td></td>
</tr>
<tr>
<td></td>
<td>8/17/49 P</td>
<td>1611</td>
<td></td>
<td>83</td>
<td></td>
</tr>
<tr>
<td></td>
<td>8/18/49 Pick-up**</td>
<td>5621</td>
<td></td>
<td>288</td>
<td></td>
</tr>
<tr>
<td>46</td>
<td>7/21/50 P</td>
<td>990</td>
<td></td>
<td>134</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7/21/50 P_s</td>
<td>840</td>
<td></td>
<td>113</td>
<td></td>
</tr>
</tbody>
</table>

*Types of estimate are as follows:
Sch = Schumacher and Eschmeyer
P = simple Petersen
P_g = Petersen, based on size groups
P_r = Petersen, data by rotenone treatment.

**Actual pick-up following rotenone treatment.
The estimate of 23 pounds of white crappies for Pond 6 (Table 29), when added to the estimate of bluegills, suggests that this pond has a rather high carrying capacity. Lawrence (1952) estimated this pond to carry 101 to 194 pounds of bluegills, but did not estimate the crappies.

Table 29. Population Estimates, Miscellaneous Fishes 1950

<table>
<thead>
<tr>
<th>Pond number</th>
<th>Date</th>
<th>Species estimated</th>
<th>Type of estimate used*</th>
<th>Fish per acre, number</th>
<th>Standard error of estimate, lbs. per cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>8/10/50</td>
<td>Crappie</td>
<td>P</td>
<td>413</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>8/10/50</td>
<td>Crappie</td>
<td>P</td>
<td>422</td>
<td>--</td>
</tr>
<tr>
<td>6</td>
<td>8/27/50</td>
<td>Crappie</td>
<td>P</td>
<td>124</td>
<td>--</td>
</tr>
<tr>
<td>13</td>
<td>8/11/50</td>
<td>Orangespotted</td>
<td>Sch</td>
<td>891</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td>8/17/50</td>
<td>sunfish</td>
<td>P</td>
<td>783</td>
<td>35</td>
</tr>
</tbody>
</table>

*Types of estimate are as follows:

Sch = Schumacher and Eschmeyer
P = simple Petersen
P = Petersen, based on size groups
P = Petersen, data by rotenone treatment.

The orangespotted sunfish listed for Pond 13 was undoubtedly part of the stocking combination five years previous and had apparently maintained a relatively stable position in competition with bluegills, for estimated poundages are not greatly different. The combined estimated poundage for the two sunfishes in this pond was 98 to 115 pounds per acre.
VII. EXPERIMENTAL POPULATION MANAGEMENT

Livestock have priority usage of the water in Iowa farm ponds and it is not generally possible to drain and restock ponds containing unsatisfactory fish populations. On this basis some attempts were made to revive fish populations in the study ponds by several different methods.

A. Supplemental Stocking

In the few years prior to the present study, technicians of the Marion County Soil Conservation District attempted to correct existing unbalanced populations by a second stocking of bass or bluegills or both. In the present study further attempts of this nature were made to bring ponds back into effective production. Fingerling bass and bluegills were moved from nearby ponds where reproduction was known to be high, and rates of stocking were usually somewhat higher than an original stocking. In some cases yearling bass or adult bluegills were used rather than fingerlings (Ponds 3, 27, 30). As shown by Table 30, most of the attempts have failed, probably for the same reasons that the first stockings failed in those ponds. Restocking attempts are not apt to succeed in ponds that tend to be at low level during the winter or that have a history of previous winterkill.
Table 30. Results of Supplemental Stocking in Unbalanced Farm Ponds, 1946 - 1950

<table>
<thead>
<tr>
<th>Year of pond stocking</th>
<th>Pond supplemental numbers stocked</th>
<th>Species stocked</th>
<th>Results of stocking</th>
</tr>
</thead>
<tbody>
<tr>
<td>1946</td>
<td>14</td>
<td>Bass</td>
<td>Success</td>
</tr>
<tr>
<td>1946</td>
<td>16,33</td>
<td>Bass and bluegills</td>
<td>Failure in Pond 16, success in Pond 33</td>
</tr>
<tr>
<td>1947</td>
<td>20,49</td>
<td>Bass</td>
<td>Success in Pond 20, failure in Pond 49</td>
</tr>
<tr>
<td>1948</td>
<td>7,32,46</td>
<td>Bass</td>
<td>Failure in all ponds</td>
</tr>
<tr>
<td>1950</td>
<td>24,30,49</td>
<td>Bass</td>
<td>Failure in Pond 24, success in Ponds 30 and 49</td>
</tr>
<tr>
<td>1950</td>
<td>16</td>
<td>Bluegill</td>
<td>Failure</td>
</tr>
<tr>
<td>1950</td>
<td>16</td>
<td>Bass and bluegills</td>
<td>Failure</td>
</tr>
<tr>
<td>1951</td>
<td>16</td>
<td>Bass and bluegills</td>
<td>Results not known</td>
</tr>
</tbody>
</table>
E. Rotenone Treatment and Restocking

In all, eight ponds of the 60 in the Marion County study area have been treated with rotenone to remove undesirable populations. Two ponds were treated in 1948 by previous investigators, and the other six were treated during the present study. Information on these treatments is tabulated in Table 31.

It is obvious that treatment with rotenone is not often 100 percent effective in eradication resistant species such as bullheads. In spite of this failure in getting complete kills of bullheads, rotenone treatment and subsequent restocking have been effective in re-establishing some farm fish ponds. Ponds restocked with bass and bluegills the same fall have not shown heavy bullhead reproduction the following year, except where the restocked fish failed to survive.

C. Removal by Seine

One attempt was made to control a fish population by seining and removal. On inspection of Pond 6 in early summer of 1950, there appeared to be large numbers of adult white crappies and very large numbers of young-of-year crappies, plus good reproduction of bass and some reproduction of bullheads. Because it seemed likely that the crappies would soon dominate the pond an effort was made to remove as many of the crappies as possible. All that could be
Table 31. Rotenone Treatment of Eight Farm Ponds

<table>
<thead>
<tr>
<th>Pond number</th>
<th>Year treated</th>
<th>Species present</th>
<th>Success of treatment and restocking</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>1948</td>
<td>Bullheads</td>
<td>Complete kill; pond successfully restocked</td>
</tr>
<tr>
<td>29</td>
<td>1948</td>
<td>Bluegills, black crappies, bullheads, golden shiners</td>
<td>Kill of all but a very few bullheads; successfully restocked</td>
</tr>
<tr>
<td>16</td>
<td>1949</td>
<td>Bullheads</td>
<td>Incomplete kill; never successfully restocked</td>
</tr>
<tr>
<td>41</td>
<td>1949</td>
<td>Bullheads</td>
<td>Kill of all but a few bullheads; successfully restocked</td>
</tr>
<tr>
<td>54</td>
<td>1949</td>
<td>Bullheads</td>
<td>Kill of all but a few bullheads; successfully restocked</td>
</tr>
<tr>
<td>55</td>
<td>1949</td>
<td>Bullheads</td>
<td>Kill of all but a few bullheads; not restocked immediately, bullheads reproduced and had to be treated a second time</td>
</tr>
<tr>
<td>2</td>
<td>1950</td>
<td>Bass, bluegills, crappies</td>
<td>Kill thought to be nearly complete; success of restocking unknown bullheads</td>
</tr>
<tr>
<td>13</td>
<td>1950</td>
<td>Bluegill, orange spotted sunfish, bullheads</td>
<td>Kill thought complete</td>
</tr>
<tr>
<td>55</td>
<td>1950</td>
<td>Bullheads</td>
<td>Kill thought complete</td>
</tr>
</tbody>
</table>
economically taken with a large 60 foot seine were removed, as were large numbers of the young-of-year crappies. The population estimated during this seining was estimated at 124 crappies, and 105 were removed. Study of scales from these crappies and from a series of 45 crappies taken the following year showed that the year class so prominent in 1950 had increased from a mean length of 7.5 inches to a mean-length of 10.8 inches in the year's time. In the same time the 1950 class had grown to a length of 6.7 inches.
VIII. SUMMARY

1. This study was conducted to ascertain the present condition of farm fish ponds in a limited area and to search for factors in their history primarily contributing to success or lack thereof of their fish populations.

2. Data for 60 farm fish ponds in Marion County, Iowa, were gathered from records of the local Soil Conservation District, the farm people on the land, and by personal investigation of the ponds and their fishes, and are preserved for use of future investigators.

3. Most of the ponds studied were constructed on silt loam soils and may be in contact with clay sub-soils.

4. The ponds received a preliminary inspection of a general nature and, if the pond and its fish population justified it, then a detailed study of the fish population was made over one or more summers. Fish were gathered by seining, trapping and rotenone treatment, and data on length, weight and age of individual fish collected. Populations of each fish were estimated where possible to do so by the marking and recovery technique.

5. A successful fish pond is defined as one providing, or capable of providing, a crop of harvestable fish over a period of years.

6. Size of the ponds studied varied from one-tenth acre to two acres. There was little discernible relationship between pond
size and success, other than that ponds smaller than one-half acre were less successful than ponds one-half acre and larger. Ponds one-tenth acre in size were not successful.

7. The bass-bluegill combination produced fishing in new ponds within two years under favorable conditions. Fifteen of 26 bass-bluegill ponds were successful, and four of 18 bass-bluegill-bullhead ponds were successful. Bass appeared able to control reproduction of bullheads in the average pond.

8. There was little discernible correlation between stocking ratios of bluegills to bass and success. The rates of stocking within the range of 300 to 1000 bluegills per acre in combination with bass had little influence on future success or failure. Populations in some fish ponds were successful over a long period of years.

9. Fencing the pond area to exclude livestock was almost the only pond management practice widely complied with. Fertilization as a management practice, even when recommended, was not widely accepted by pond owners.

10. Very few of the ponds supported any amount of fishing. Harvest at the most heavily fished ponds did not exceed 65 pounds of fish per acre per year.

11. Turbidity due to fine suspended clay was probably a factor delaying growth of bass. Aquatic vegetation was not an important factor in determining success of fish populations in this series of ponds.
12. The minnow seine technique advocated by Swingle was used in the preliminary and some periodic inspections of the ponds and gave fair results compared with information revealed by larger seines. The method was not always properly timed to detect young-of-year fish and did not always detect bullhead populations.

13. The length-weight relationship of the largemouth bass was best described by the equation:

\[ \log W = -1.450 + 3.136 \log L \]

which indicates that the weight of an individual bass increased somewhat more rapidly than the cube of the total length.

14. The bass in the present study were in relatively poor condition compared with bass from other areas, but grew more rapidly than those from other Iowa impoundments and better than the average of those from some midwestern lakes. Bass in Iowa ponds reached the legal length of ten inches during their third summer of life. They reached minimum spawning size during their third summer and probably spawned for the first time the following spring. Bass in newly stocked ponds grew more rapidly and usually spawned as two-year olds. Spawning occurred annually for the most part.

15. The length-weight relationship of the bluegill was best described by the formula:

\[ \log W = -1.360 + 3.282 \log L \]

which indicates that the bluegills increased in weight somewhat more rapidly than the cube of the total length.
16. The bluegills from the farm ponds were poor to average in relative plumpness. Growth of bluegills in ponds having balanced populations was generally good, total lengths at successive annuli being 1.7, 4.1, 6.1, and 7.0 inches. Growth in ponds not displaying balanced populations was noticeably slower. In new ponds bluegills usually reached spawning size at one year of age, but growth in established ponds was slower, and bluegills probably did not spawn at one year. In the Iowa ponds the time of bluegill spawning was shown to vary widely, in some cases there was no apparent hatch of bluegills until August.

17. White crappies seemed to reproduce almost annually in Iowa farm ponds. The weight of crappies increased slightly more rapidly than did the cube of the length. Crappies from two of the ponds were intermediate in plumpness when compared with those reported in other Iowa studies. Growth of the crappie was rather slow in the ponds studied, three growing seasons being necessary to produce a fish of harvestable size.

18. Ponds that were rated as being successful gave population estimates for bluegills generally ranging from 100 to 400 pounds per acre. Ponds that were rated as being unsuccessful gave estimates of bluegills considerably lower, such estimates ranging from 30 to 75 pounds. Estimates of bass were obtained for only three ponds, all of which had been classified as being successful.
19. Attempts to correct existing unbalanced populations by a supplemental stocking of bass or bluegills or both were not often successful, usually because of winterkill. Rotenone treatment and subsequent restocking were generally successful in re-establishing fish ponds, even where bullheads were not entirely eliminated by the rotenone. One attempt to control a heavy population of white crappies by seining and removal resulted in greatly increased growth of the remaining crappies but did not eliminate them or their reproduction.
IX. LITERATURE CITED


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X. ACKNOWLEDGEMENTS

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Dr. Kenneth D. Carlander supervised the research and preparation of the thesis. His continued interest and encouragement are deeply appreciated and are gratefully acknowledged. Thanks are also due fellow graduate students C. E. Ruhr, Paul Osborn and John Lawrence for their aid in the field.

Lastly the author wishes to express his thanks and appreciation to his wife, Ruth E. Moorman, for her patience and her sacrifices during the course of study and preparation of the thesis.
XI. APPENDIX
Pond 1 Data

NAME: Wyatt Applegate

LOCATION: NE1/4 Section 13 T74N R20W, Marion County, Iowa

SIZE: 0.6 acre

GROUND COVER ON LAND DRAINED: 70 percent timothy, 30 percent row crops

SHALLOW WATER VEGETATION: A few cattails and numerous seedling willows in 1951

STOCKING HISTORY: 1949—30 largemouth bass, 300 bluegills, all fingerlings

MANAGEMENT: Fenced from livestock

INSPECTIONS: July 13, 1951—Young-of-year bass, abundant young-of-year bluegills, 1 two-inch bluegill; water colored gray-brown with suspended clay

POPULATION ESTIMATES: An attempt to trap enough fish for a population estimate was made in August, 1951 but catch was very meager and attempt was canceled.

REMARKS: Pond thought to be infertile, fish population low
Pond 2 Data

NAME: Avery Brothers

LOCATION: NW1/4 Section 13 T74N R19W Marion County, Iowa

SIZE: 0.36 acre

GROUND COVER ON LAND DRAINED: Tall bluegrass and miscellaneous herbs and shrubs

SHALLOW WATER VEGETATION: Occasional rushes and willows

STOCKING HISTORY: 1944--Bullheads, crappies, bass, bluegills and green sunfish stocked from the creek
1945--25 largemouth bass, 250 bluegills, all fingerlings
1950--Restocked with bass and bluegills after treatment with rotenone

MANAGEMENT: Brushpiles and rockpiles installed for fish "shelter" at time pond was built
Pond area fenced from livestock
Pond treated with rotenone in 1950 and then restocked

INSPECTIONS: July 15, 1950--Abundant young-of-year bass, abundant young-of-year white crappies, some young-of-year bluegills, some young-of-year bullheads, some two-inch and larger bluegills

POPULATION ESTIMATES: August, 1950--Recovery of fish following treatment with rotenone gave estimates of 12 bass, 126 to 128 bluegills, 149 to 154 white crappies, 58 bullheads, for a total weight of 80.7 pounds

REMARKS: Fish marked for population estimate August 7, 1950, but because of brush and rock obstructions, too few fish could be recovered with the seine for an estimate to be made.
Study of scales from fish taken in 1950 indicated the 1946, the 1947 and the 1949 year classes of bass present; the 1947, the 1948 and the 1949 year class of bluegills present; the 1945, 1946, 1947, 1948, 1949, 1950 year classes of white crappies present.
Pond 3 Data

NAME: Howard Beebout

LOCATION: NEL/4SW1/4 Section 13 T74N R20W Marion County, Iowa

SIZE: 0.3 acre

GROUND COVER ON LAND DRAINED: 70 percent bluegrass, 30 percent row crops

SHALLOW WATER VEGETATION: None

STOCKING HISTORY: 1944--20 largemouth bass, 150 bluegills, 20 black bullheads, all fingerlings
1948--Adult bluegills added after inspection showed two sizes of bass, some bullheads, but no bluegills

MANAGEMENT: Fenced from livestock

INSPECTIONS: July 12, 1949—Pale three-inch bluegills, one large black bullhead, one unidentified minnow; pond very muddy.

POPULATION ESTIMATES: Not made

REMARKS: 1943--Pond used as a source of bass for stocking
Apparent winterkill of fish 1948-1949
Pond 4 Data

NAME: Virgil Beebout

LOCATION: SW1/4 Section 16 T74N R20W Marion County, Iowa

SIZE: 0.25 acre

GROUND COVER ON LAND DRAINED: Sparse bluegrass pasture

SHALLOW WATER VEGETATION: Some cattails in 1950, many cattails in 1951

STOCKING HISTORY: 1947—50 largemouth bass, 500 bluegills, all fingerlings

MANAGEMENT: Fenced from livestock

INSPECTIONS: July 12, 1949—Young-of-year bluegills; 1 six-inch bass, two-inch bluegills, adult bluegills; water muddy with fine clay
July 15, 1950—Young-of-year bass, young-of-year bluegills; two-inch and three-inch bluegills; water muddy with fine clay
June 27, 1951—Abundant young-of-year bass, young-of-year bluegills, young-of-year goldfish; water muddy with fine clay

POPULATION ESTIMATES: Not made

REMARKS: Water apparently continuously muddy with fine clay.
Farmer reported partial winterkill of fish 1950–1951
Pond 5 Data

NAME: Ray Beem

LOCATION: SE1/4 Section 5 T74N R20W Marion County, Iowa

SIZE: 0.5 acre

GROUND COVER ON LAND DRAINED: 90 percent bluegrass pasture, 10 percent contoured rowcrops

SHALLOW WATER VEGETATION: Some willows, much filamentous algae, some patches of Potamogeton Spirillus, some Scirpus atrovirens

STOCKING HISTORY: 1943—30 largemouth bass, 400 bluegills, all fingerlings

MANAGEMENT: Fenced from livestock

INSPECTIONS: June 30, 1949—Young-of-year bass, young-of-year bluegills; 1 nine-inch bass, abundant two-inch and larger bluegills

July 11, 1950—Young-of-year bass, young-of-year bluegills; five-inch bass, tremendous numbers of three-inch bluegills; water muddy

June 28, 1951—Young-of-year bass, 1 young-of-year bluegill; two-inch bluegills; water brown with plankton algae

August 22, 1951—Few young-of-year bass, two sizes of young-of-year bluegills; one six-inch bass, few three-inch bluegills

POPULATION ESTIMATES: No estimates possible in 1950 and 1951 because of interference with seine by filamentous algae

REMARKS: Pond reportedly produced good fishing in 1947 and 1948

Study of scales from fish taken July 13, 1950, indicated that bass 2.4 inches to 3.5 inches long were young-of-the-year.
Pond 6 Data

NAME: William Blackman (North)

LOCATION: SE1/4 Section 31 T74N R19W Marion County, Iowa

SIZE: 0.7 acre

GROUND COVER ON LAND DRAINED: Red clover and bluegrass

SHALLOW WATER VEGETATION: Outgrass (Leersia) and Reed Canary Grass

STOCKING HISTORY: 1944—20 largemouth bass, 150 bluegills, 25 black bullheads, 30 white crappies, all fingerlings

MANAGEMENT: Fenced from livestock
Fertilized with 5-5-5 analysis fertilizer in 1949, 200 pounds in 1950, 120 pounds in 1951.
105 white crappies removed by seine in 1950
Fished by farm family as field work permitted, with set lines, bank poles and fly rods.

INSPECTIONS: July 15, 1950—Young-of-year bass, young-of-year crappies; water colored brown with plankton algae; examination of stomach contents of several heavy-bodied young-of-year bass revealed young crappies and young bullheads.
August 8, 1950—Young-of-year bass, very many small young-of-year bluegills, young-of-year crappies
June 26, 1951—Many young-of-year bass
August 3, 1951—Young-of-year bass, young-of-year crappies
August 27, 1951—Young-of-year bass, young-of-year crappies

POPULATION ESTIMATES: July 15, 1950—Estimate by marking and recapture with seine of 1516 bluegills, 238 to 244 crappies
August 8, 1950—Estimate by recapture with seine of 1,422 bluegills, 90 crappies
August 3, 1951—Estimates by marking and recapture with seine of 839 bluegills, 87 crappies
August 21, 1951—Estimate by angling of 1700 bluegills
August 27, 1951—Estimates by recapture by seine of 1,917 bluegills
August, 1951—Estimates by marking and recapture with traps of 2,550 to 2,608 bluegills1 for a total of 156 to 150 pounds

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Pond 6 Data (continued)

Pond 7 Data

NAME: William Blackman (West)

LOCATION: SE1/4 Section 31 T74N R19W Marion County, Iowa

SIZE: 0.3 acre

GROUND COVER ON LAND DRAINED: Bluegrass pasture

SHALLOW WATER VEGETATION: Some cattails

STOCKING HISTORY: 1946—25 largemouth bass fingerlings stocked over existing population of bluegills, green sunfish, white crappies

MANAGEMENT: Fenced from livestock

INSPECTIONS: July 14, 1950—Three-inch and four-inch bluegills, green sunfish and orange-spotted sunfish, five-inch crappies

POPULATION ESTIMATES: Not made

REMARKS: Pond never fished by anyone.
Pond 8 Data

NAME: Antoine Blom

LOCATION: NW1/4 Section 36 T77N R18W Marion County, Iowa

SIZE: 0.33 acre

GROUND COVER ON LAND DRAINED: Timothy pasture

SHALLOW WATER VEGETATION: A few cattails

STOCKING HISTORY: 1949—25 largemouth bass, 250 bluegills, all fingerlings

MANAGEMENT: Fenced from livestock

INSPECTIONS: July 31, 1951—Young-of-year bass, young-of-year bluegills; very many bluegills 1 1/2 to 3 1/2 inches long; water brown with plankton algae, some filamentous algae along shorelines

POPULATION ESTIMATES: Not made

REMARKS: None
Pond 9 Data

NAME: Lawrence Blom

LOCATION: SW1/4 Section 25 T76N R13W Marion County, Iowa

SIZE: 0.3 acre

GROUND COVER ON LAND DRAINED: Alfalfa

SHALLOW WATER VEGETATION: None

STOCKING HISTORY: 1948—Black bullheads
1948—30 largemouth bass, 300 bluegills, all fingerlings
1951—35 largemouth bass, 300 bluegills, all fingerlings

MANAGEMENT: 1948—Chemically treated with rotenone, then restocked and fertilized with 80 pounds of 4-16-0 analysis fertilizer
1949—Fertilized with 80 pounds of 8-8-8 analysis fertilizer

INSPECTIONS: July 19, 1948—Adult bullheads
July 13, 1949—Young-of-year bluegills; seven-inch bass, adult bluegills
July 18, 1950—Young-of-year bass, young-of-year bluegills; adult bass, three-inch and larger bluegills; water low and muddy
August 2, 1951—No fish present

POPULATION ESTIMATES: July, 19482—An estimate by marking and recapture with seine of 769 bullheads; an estimate by later recovery through rotenone treatment of 1,964 bullheads

REMARKS: 1950-1951—Winterkill under conditions of low water level

1 Kenneth D. Carlander. 1948. Manuscript data, on file, Iowa Cooperative Fisheries Research Unit.

Pond 10 Data

NAME: O. S. Bowery

LOCATION: NW1/4 Section 28 T76N R21W Marion County, Iowa

SIZE: 0.3 acre

GROUND COVER ON LAND DRAINED: Bluegrass pasture

SHALLOW WATER VEGETATION: None

STOCKING HISTORY: 1945—15 largemouth bass, 110 bluegills, 10 black bullheads, all fingerlings

MANAGEMENT: None

INSPECTIONS: July 11, 1949—Many small bullheads
            July 30, 1951—Young-of-year bullheads; water dark brown with roiled mud, pond apparently badly silted

POPULATION ESTIMATES: Not made

REMARKS: None
Pond 11 Data

NAME: John Brucklander

LOCATION: NW1/4 Section 13 T74N R20W Marion County, Iowa

SIZE: 0.4 acre

GROUND COVER ON LAND DRAINED: Bluegrass pasture

SHALLOW WATER VEGETATION: None

STOCKING HISTORY: 1949--18 largemouth bass, 180 bluegills, all fingerlings, stocked over an existing population of black bullheads

MANAGEMENT: No attempts at management by the farmer

INSPECTIONS: July 13, 1951--Many young-of-year bullheads; some four-inch bullheads; water khaki-colored with suspended clay

POPULATION ESTIMATES: Not made

REMARKS: Pond accessible to livestock; bass and bluegills apparently winterkilled 1949-50 or 1950-51
Pond 12 Data

NAME: Billy Bye

LOCATION: SW1/4 Section 22 T75N R20W Marion County, Iowa

SIZE: 0.3 acre

GROUND COVER ON LAND DRAINED: 90 percent bluegrass, 10 percent row crops

SHALLOW WATER VEGETATION: Cutgrass (Leersia)

STOCKING HISTORY: 1945—50 largemouth bass, 750 bluegills, indefinite number of golden shiners, all fingerlings

MANAGEMENT: Fenced from livestock

INSPECTIONS: July 20, 1948\(^1\)—Young-of-year bluegills; yearling and adult bluegills
July 14, 1950—Young-of-year bass, abundant young-of-year bluegills, two-inch and larger bluegills, three-inch and larger golden shiners; water brown with plankton algae
June 28, 1951—Many young-of-year bass, some young-of-year bluegills, two-inch and three-inch bluegills
August 29, 1951—Young-of-year bass, young-of-year bluegills; one large bluegill, one five-inch golden shiner; water brown with plankton algae

POPULATION ESTIMATES: July 22, 1948\(^2\)—An estimate by marking and recapture with seine of 12 bass, 351 bluegills, 22 golden shiners
July 14, 1950—An estimate by marking and recapture with seine of 23 bass, 393 bluegills, 15 golden shiners

REMARKS: Study of scales showed presence of 1948 year class of bass although seine inspection did not reveal any young that year. Study of scales of fish taken in 1950 showed the 1947, 1948, 1949 and 1950 year classes of bass, and the 1947, 1948 and 1949 year classes of bluegills were successful

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\(^1\) Kenneth D. Carlander. 1948. Manuscript data, on file, Iowa Cooperative Fisheries Research Unit.

Pond 13 Data

NAME: Noel Chambers

LOCATION: NW1/4 Section 23 T76N R21W Marion County, Iowa

SIZE: 0.33 acre

GROUND COVER ON LAND DRAINED: 80 percent mixed herbs and grasses, 20 percent contoured row crops

SHALLOW WATER VEGETATION: Extensive cattails in shallow upper end of pond

STOCKING HISTORY: 1945—3 largemouth bass, 75 bluegills, 5 black bullheads, all fingerlings
1950—After rotenone treatment, restocked with 20 largemouth bass, 200 bluegills, all fingerlings

MANAGEMENT: Fenced from livestock
Unbalanced population treated with rotenone in 1950, and pond restocked

INSPECTIONS: July 18, 1950—Few young-of-year bluegills (?); many three-inch and four-inch bluegills, many three-inch and four-inch orange spotted sunfish; water muddy with fine suspended clay
August 7, 1950—Same as above with addition of young-of-year bullheads; adult bullheads

POPULATION ESTIMATES: August 11, 1950—Estimate by marking and recapture with seine of 740 bluegills, 297 orange-spotted sunfish, 126 bullheads
Estimate by recovery with rotenone treatment of 1 bass, 621 bluegills, 261 orange-spotted sunfish, 3,546 black bullheads

REMARKS: Farmer reported catching and removing one of the three bass the year after stocking
Study of scales of the one bass taken in 1950 showed it belonged to the 1945 year class.
Fond 14 Data

NAME: Boyd Coffman

LOCATION: NE1/4 Section 29 T74N R20W Marion County, Iowa

SIZE: 0.5 acre

GROUND COVER ON LAND DRAINED: Bluegrass pasture

SHALLOW WATER VEGETATION: Reed canary grass, some willows

STOCKING HISTORY: 1944--15 largemouth bass, 150 bluegills, 25 black bullheads, all fingerlings
1946--15 largemouth bass fingerling added after seine sampling showed only bluegills present

MANAGEMENT: Fenced from livestock, and area within the fence planted to trees

INSPECTIONS: July 12, 1949--1 twelve-inch bass, many five-inch bluegills
June 13, 1950--Young-of-year bass; ten-inch bass, five-inch bluegills; many bullfrog tadpoles
June 29, 1951--Three-inch to five-inch bluegills
August 28, 1951--Young-of-year bluegills; 1 five-inch bass, five-inch bluegills; water brown with plankton algae

POPULATION ESTIMATES: June 14, 1950--Estimate by marking and recapture with seine of 6 bass, 837 bluegills, 37 bullheads

REMARKS: Trees about pond hinder wind movements and interfere with fishing
Inspections in June of 1950 and June of 1951 were probably too early seasonally to detect young bluegills
Study of scales of fish taken in 1950 showed that the 1949 year class of bass and the 1946, 1947, 1948 and 1949 year classes of bluegills were successful.
Fond 15 Data

NAME: Harold Dale Core

LOCATION: SE1/4 Section 9 T76N R20W Marion County, Iowa

SIZE: 0.5 acre

GROUND COVER ON LAND DRAINED: 1949—50 percent bluegrass, 50 percent row crops
1951—50 percent bluegrass, 50 percent hay crops

SHALLOW WATER VEGETATION: None

STOCKING HISTORY: 1947—70 largemouth bass, 700 bluegills, all fingerlings

MANAGEMENT: Fenced from livestock

INSPECTIONS: June 28, 1949—One young-of-year bass; several two-inch bluegills, several three-inch black bullheads, many blunt-nosed minnows; water muddy
July 12, 1949—One young-of-year bass; some two-inch bluegills, 1 fourteen-inch bass, very many blunt-nosed minnows; water muddy
August 9, 1950—Young-of-year bluegills, young-of-year minnows; three-inch bluegills, three-inch minnows; water muddy
July 31, 1951—2 young-of-year bullheads, very many minnows of all sizes; water brown with plankton algae

POPULATION ESTIMATES: Not made

REMARKS: During fall of 1950 farmer removed with seine 3 large bass totalling nine pounds
Pond 16 Data

NAME: Don Den Adel

LOCATION: SW1/4 Section 16 T77N R15W Marion County, Iowa

SIZE: 0.7 acre

GROUND COVER ON LAND DRAINED: 50 percent in bluegrass-timber pasture, 50 percent in crop land

SHALLOW WATER VEGETATION: Outgrass (Leersia)

STOCKING HISTORY: 1944—Largemouth bass, bluegills, black bullheads, all fingerlings
1945—Largemouth bass, bluegills, all fingerlings
1948—80 largemouth bass, 800 bluegills, all fingerlings
1949—35 largemouth bass, 350 bluegills, all fingerlings
1950—Experimental stocking of 40 yearling bass
1951—50 largemouth bass fingerlings

MANAGEMENT: 1948—Fertilized with 280 pounds of 8-8-8 analysis fertilizer
1949—Fertilized with 120 pounds of 8-8-8 analysis fertilizer
1949—Pond treated with rotenone, then restocked

INSPECTIONS: July 13, 1949—many small bullheads
July 18, 1950—numerous young-of-year bullheads; water colored deep green with plankton algae
July 31, 1951—1 five-inch bullhead; water colored dark brown with plankton algae

POPULATION ESTIMATES: August 17, 1949—An estimate by marking and recovery with seine of 3,805 bullheads
August 18-20, 1949—Pick-up of fish killed by rotenone treatment totaled 8,679 bullheads or 517 pounds

REMARKS: Farmer reported the bass and bluegills of 1944 stocking died "almost immediately" after stocking
Farmer reported the 1946 stocking died during the winter of 1947-1948, when water level was down to a maximum of 4 feet
In 1949 stocking of bass and bluegills had disappeared by the following summer
Water levels approximately three feet below spillway by mid-summer of both 1950 and 1951
Pond 17 Data

NAME: Ward Duncan

LOCATION: SW1/4 Section 33 T75N R20M Marion County, Iowa

SIZE: 0.5 acre

GROUND COVER ON LAND DRAINED: Bluegrass pasture

SHALLOW WATER VEGETATION: None

STOCKING HISTORY: 1951-24 largemouth bass, 240 bluegills, all fingerlings

MANAGEMENT: None

INSPECTIONS: July 13, 1951—Young-of-year bass, young-of-year bluegills; 1 two-inch bluegill, 1 eight-inch bass; water colored gray with suspended clay
August 30, 1951—Few young-of-year bass, abundant young-of-year bluegills; some two-inch to five-inch bluegills, 1 nine-inch bass; water gray with suspended clay

POPULATION ESTIMATES: Not made

REMARKS: None
Pond 18 Data

NAME: Tim Fee

LOCATION: NE1/4 Section 9 T75N R20W Marion County, Iowa

SIZE: 0.4 acre

GROUND COVER ON LAND DRAINED: Shrubby bluegrass pasture

SHALLOW WATER VEGETATION: Some cattails, some Alisma subcordatum

STOCKING HISTORY: 1946--40 largemouth bass, 400 bluegills, all fingerlings

MANAGEMENT: Fenced from livestock

INSPECTIONS: July 11, 1949—Young-of-year bluegills; 2 seven-inch bass; water muddy with suspended clay
June 15, 1950—Some young-of-year bluegills, several eight-inch bass, three-inch to six-inch bluegills; water muddy
June 28, 1951—Young-of-year bluegills, 1 eight-inch bass, two-inch and larger bluegills; water very muddy with suspended clay
August 23, 1951—Young-of-year bass, two sizes of young-of-year bluegills; water muddy with suspended clay

POPULATION ESTIMATES: June 17, 1950--Estimates by marking and recapture with seine of 123 bluegills, 4 bass, for a total of 15 pounds

REMARKS: Study of scales taken in 1950 indicated presence of 1948 year class of bass, and 1946, 1947, 1948 and 1949 year classes of bluegills
Pond 19 Data

NAME: Tom Pinarty

LOCATION: SE1/4 Section 4 T74N R20W Marion County, Iowa

SIZE: 0.2 acre

GROUND COVER ON LAND DRAINED: Timber

SHALLOW WATER VEGETATION: Some cattails, some sedges

STOCKING HISTORY: 1946—10 largemouth bass, 100 bluegills, all fingerlings
1949—Experimental stocking of 30 bass fingerlings

MANAGEMENT: None

INSPECTIONS: June 30, 1949—Two-inch and four-inch bluegills
June 29, 1951—Two-inch to three-inch bluegills

POPULATION ESTIMATES: Not made

REMARKS: None
Pond 20 Data

NAME: Richard Fortner

LOCATION: NE 1/4 Section 2 T74N R20W Marion County, Iowa

SIZE: 0.2 acre

GROUND COVER ON LAND DRAINED: 85 percent bluegrass pasture, 15 percent row crops

SHALLOW WATER VEGETATION: None

STOCKING HISTORY: 1943—15 largemouth bass, 150 bluegills, all fingerlings 1947—50 bass fingerlings added after test seining failed to locate bass

MANAGEMENT: Fenced from livestock in 1949, open to livestock in 1951

INSPECTIONS: July 13, 1949—Young-of-year bass, young-of-year bluegills, five-inch bluegills; water muddy

POPULATION ESTIMATES: Not made

REMARKS: None
Pond 21 Data

NAME: J. W. Frecl

LOCATION: NE1/4 Section 16 T76N R21W Marion County, Iowa

SIZE: 1.2 acres

GROUND COVER ON LAND DRAINED: 90 percent timber pasture, 10 percent row crops

SHALLOW WATER VEGETATION: None

STOCKING HISTORY: 1949—60 largemouth bass, 600 bluegills, all fingerlings, apparently over a previous stocking of bullheads 1951—1500 bullheads, all yearling or larger

MANAGEMENT: Open to unrestricted public fishing

INSPECTIONS: July 31, 1951—Many young-of-year bluegills, some young-of-year bullheads; much blue-green algae visible in shallow water

POPULATION ESTIMATES: Not made

REMARKS: Spillway severely eroded in 1951

Much metal junk visible in shallow water
Pond 22 Data

NAME: J. Lawrence Goff

LOCATION: Section 22 T75N R20W Marion County, Iowa

SIZE: 0.5 acre

GROUND COVER ON LAND DRAINED: Overgrazed bluegrass

SHALLOW WATER VEGETATION: A few cattails in 1950

STOCKING HISTORY: 1944—15 largemouth bass, 200 bluegills, 10 white crappies, 30 black bullheads, all fingerlings

MANAGEMENT: None

INSPECTIONS: July 15, 1950—Young-of-year bass, young-of-year bluegills, young-of-year white crappies; two-inch and larger bluegills, five-inch crappies, 1 seven-inch bass; water muddy

POPULATION ESTIMATES: Not made

REMARKS: Spillway cutting badly in 1950
Pond 23 Data

NAME: Paul Harp

LOCATION: NE 1/4 Section 10 T76N R26W Marion County, Iowa

SIZE: 0.6 acre

GROUND COVER ON LAND DRAINED: Bluegrass

SHALLOW WATER VEGETATION: None

STOCKING HISTORY: 1943—30 largemouth bass, 300 bluegills, 25 bullheads, all fingerlings

MANAGEMENT: None

INSPECTIONS: July 21, 1943—Adult bluegills, adult crappies, adult green sunfish, adult orange spotted sunfish
June 23, 1949—Young-of-year crappies
August 9, 1950—Few young-of-year crappies, few five-inch crappies

POPULATION ESTIMATES: July 21, 1948—Estimate by marking and recovery with seine of 3 bass, 355 bluegills, 216 crappies, 114 bullheads, 10 orange spotted sunfish

REMARKS: Water low in 1949, seepage through the dam apparent
Water only 2 1/2 feet deep in 1950

1Kenneth D. Carlander. 1948. Manuscript data, on file, Iowa Cooperative Fisheries Research Unit.

Pond 24 Data

NAME: Alban Hoch

LOCATION: SE1/4 Section 6 T74N R21W Marion County, Iowa

SIZE: 0.5 acre

GROUND COVER ON LAND DRAINED: Bluegrass pasture (some drainage comes from county road)

SHALLOW WATER VEGETATION: None

STOCKING HISTORY: 1947--10 largemouth bass, 100 bluegills, all fingerlings
1948--70 largemouth bass, 700 bluegills, all fingerlings
1950--Experimental stocking of 14 yearling bass

MANAGEMENT: None

INSPECTIONS: July 12, 1950--Large numbers of three-inch bluegills
July 30, 1951--Abundant four-inch and five-inch bluegills

POPULATION ESTIMATES: Not made

REMARKS: 1950--Water low, roily, used continuously by 100 geese
1951--Water low, roily, used continuously by 250 geese
Pond 25 Data

NAME: James Holland

LOCATION: NW1/4 Section 11 T75N R21W Marion County, Iowa

SIZE: 0.6 acre

GROUND COVER ON LAND DRAINED: 20 to 50 percent in row crops through the years 1949 to 1951

SHALLOW WATER VEGETATION: Mature willows along the dam side, much *Scirpus atrovirens* at upper end

STOCKING HISTORY: 1942—25 bullheads
1943—20 largemouth bass, 180 bluegills, all fingerlings
A few small bullheads from the nearby creeks were added from time to time by the farm family

MANAGEMENT: Fenced from livestock
Willow trees on the dam cut down in 1951

INSPECTIONS: July 1947—Newly hatched young-of-year bluegills
July, 1948—Young-of-year bass, young-of-year bluegill
June 28, 1949—Abundant young-of-year bass, adult bluegills
June 15, 1950—Young-of-year bass; abundant three-inch to six-inch bass
June, 1951—Abundant young-of-year bass, few young-of-year bluegills
August 29, 1951—Two-inch young-of-year bass, one-inch young-of-year bluegills; 1 five-inch bass; water brown with plankton algae

POPULATION ESTIMATES: 1947—Estimate by marking and recapture with seine of 100 bass, 814 bluegills, totaling 304 pounds

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2. Kenneth D. Carlander. 1948. Manuscript data, on file, Iowa Cooperative Fisheries Research Unit.
Pond 25 Data (continued)

POPULATION ESTIMATES: 1948—Estimate by marking and recapture with seine of 54 bass, 323 bluegills
June 16, 1950—Estimates by marking and recapture with seine of 493 bass, 197 bluegills
July 22, 1950—Estimates by marking and recovery with seine of 394 bass, 70 bluegills, for a total of 47.7 pounds
August 16, 1950—Estimates by recovery with seine of 590 bass, 17 bluegills

REMARKS: A partial winterkill reported by farmer for the winter of 1950-1951
Bass of the 1949 year class averaged 2.35 inches long on June 28 of that year, 2.90 inches long on July 12.
Fishing was very poor during 1949-1951
Study of scales from fish taken in 1950 showed the 1946, 1947 and 1949 year classes of bass were successful

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Pond 26 Data

NAME: Joe M. Johnston

LOCATION: NW1/4 Section 17 T76N R20W Marion County, Iowa

SIZE: 0.75 acre

GROUND COVER ON LAND DRAINED: Bluegrass pasture

SHALLOW WATER VEGETATION: None

STOCKING HISTORY: 1949--38 largemouth bass, 380 bluegills, all fingerlings

MANAGEMENT: Fenced from livestock at water's edge

INSPECTIONS: July 9, 1951--Many young-of-year bass, few young-of-year bluegills; very many two-inch to three-inch bluegills; water dark brown with plankton algae

POPULATION ESTIMATES: Not made

REMARKS: None
Pond 27 Data

NAME: Lowell Johnson (House)

LOCATION: Sec 1/4 Section 12 T74N R20W Marion County, Iowa

SIZE: 1.0 acre

GROUND COVER ON LAND DRAINED: 10 percent Reed canary grass, 10 percent timothy, 35 percent orchard, 45 percent row crops

SHALLOW WATER VEGETATION: Reed canary grass

STOCKING HISTORY: 1944—30 largemouth bass, 300 bluegills, 50 black bullheads, all fingerlings
1950—38 adult bluegills
1951—103 young-of-year bluegills

MANAGEMENT: Fenced from livestock

INSPECTIONS: July, 1947—Reproduction of both bass and bluegills
July 23, 1948—Bluegill fry, yearlings and adults
June 29, 1949—Young-of-year bass; two-inch to three-inch bluegills
May 26, 1950—1 eleven-inch black bullhead
July 11, 1950—Many young-of-year bass
August, 1950—Many young-of-year bass, many young-of-year bullheads
June 25, 1951—A few five-inch bullheads
July 31, 1951—A few five-inch bullheads

POPULATION ESTIMATES: Not made

REMARKS: The June 29, 1949 inspection was probably too early to detect bluegill fry
This pond produced nice catches of both bass and bluegills in 1949
Farmer reported heavy winterkill of bass and bluegills during winter of 1949-1950
Farmer reported heavy winterkill of bass, bluegills and bullheads during winter of 1950-1951

1Wallace L. Anderson. 1947. Manuscript data, on file, Iowa Cooperative Fisheries Research Unit.
2Kenneth D. Carlander. 1948. Manuscript data, on file, Iowa Cooperative Fisheries Research Unit.
Pond 25 Data

NAME: Lowell Johnson (North)

LOCATION: NE 1/4 Section 12 T74N R20W Marion County, Iowa

SIZE: 0.6 acre

GROUND COVER ON LAND DRAINED: Crops in rotation

SHALLOW WATER VEGETATION: Reed canary grass, some cattails in 1949, many cattails in 1951

STOCKING HISTORY: 1944—25 largemouth bass, 350 bluegills, 10 crappies, all fingerlings

MANAGEMENT: Fenced from livestock

INSPECTIONS: July, 1947—"Pond is in balance with reproduction of both bass and bluegills."
July 23, 1948—"Bass and bluegill fry, bluegill yearlings and adults"
June 29, 1949—Young-of-year bass, young-of-year bluegills, yearling and adult bluegills
July 11, 1950—Young-of-year bass, young-of-year bluegills; five-inch bass, two-inch and three-inch bluegills; water brown with plankton algae
June 25, 1951—Abundant young-of-year bluegills
July 9, 1951—Abundant young-of-year bass, 1 young-of-year bluegill; water brown with plankton algae
July 30, 1951—Abundant young-of-year bass; water brown in color
August 30, 1951—Many young-of-year bass; water brown in color

POPULATION ESTIMATES: June 29—July 1, 1949—Estimate by marking and recovery with seine, hoopnets and wiretraps of 315 bluegills.

REMARKS: None

1 Wallace L. Anderson. 1947. Manuscript data, on file, Iowa Cooperative Fisheries Research Unit.
2 Kenneth D. Carlander. 1948. Manuscript data, on file, Iowa Cooperative Fisheries Research Unit.
Pond 29 Data

NAME: Lowell Johnson (South)

LOCATION: SE1/4 Section 12 T74N R20W Marion County, Iowa

SIZE: 0.3 acre

GROUND COVER ON LAND DRAINED: Tall weeds and miscellaneous grasses

SHALLOW WATER VEGETATION: None

STOCKING HISTORY: 1943—largemouth bass, bluegills, bullheads, exact numbers unknown
1946—20 largemouth bass fingerlings
1948—After rotenone treatment restocked with 37 largemouth bass, 370 bluegills, all fingerlings.

MANAGEMENT: October 1948—Treated with rotenone to eliminate all fish, then restocked
Pond not available to livestock

INSPECTIONS: July 16, 1947—Young-of-year bluegills
July 1, 1949—Young-of-year bluegills; five-inch bluegills
July 11, 1950—Young-of-year bass, young-of-year bluegills;
two-inch to three-inch bluegills; water muddy with clay
June 26, 1951—3 young-of-year bass, many young-of-year bluegills, 1 eight-inch bass; water muddy with clay

POPULATION ESTIMATES: August 1947—Estimate by marking and recapture with seine of 567 bluegills, 1,352 black bullheads,
182 black crappies, 77 golden shiners, for a total of 329 pounds

REMARKS: 1951—Examination of scales from the 1 bass measuring 8.6 inches indicated that it was of the 1950 year class

1 Wallace L. Anderson. 1947. Manuscript data, on file, Iowa Cooperative Fisheries Research Unit.

2 Kenneth D. Carlander. 1947. A preliminary report on the fish populations of some farm ponds in Marion County, Iowa. 2 pp. manuscript, on file, Iowa Cooperative Fisheries Research Unit.
Pond 30 Data

NAME: Lowell Johnson (West)

LOCATION: SE 1/4 Section 12 T74N R20W Marion County, Iowa

SIZE: 0.3 acre

GROUND COVER ON LAND DRAINED: Bluegrass in 1949 and 1950, contoured corn in part in 1951.

SHALLOW WATER VEGETATION: Reed canary grass and willow sprouts

STOCKING HISTORY: 1943—60 largemouth bass, 500 bluegills, 100 bullheads, all fingerlings
1946—40 largemouth bass fingerlings stocked after fishing failed to reveal any bass
July, 1950—23 yearling bass

MANAGEMENT: 1948—Approximately 30 pounds of black bullheads removed by seine
1949—Approximately 50 pounds of black bullheads removed by seine
1950—23 yearling bass added when inspection with seine did not reveal any bass

INSPECTIONS: July 18, 1947—Very many young-of-year bass, young-of-year bluegills
July 23, 1948—Young-of-year bullheads
July 13, 1949—Young-of-year bass; 1 adult bass, adult bluegills, adult bullheads, 2 unidentified minnows
July 11, 1950—Young-of-year bluegills; yearling bluegills, adult bluegills, adult bullheads
July 30, 1951—Young-of-year bass, 3 young-of-year bluegills; 2 four-inch bullheads; water gray with suspended clay
August 30, 1951—Young-of-year bass, young-of-year bluegills; 1 four-inch bullhead; water level low, water colored brown with plankton algae

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1 Wallace L. Anderson. 1947. Manuscript data, on file, Iowa Cooperative Fisheries Research Unit.
2 Kenneth D. Carlander. 1948. Manuscript data, on file, Iowa Cooperative Fisheries Research Unit.
Pond 30 Data (continued)

POPULATION ESTIMATES: August, 1947—Estimate by marking and recapture with seine of 682 bluegills, 253 bullheads, for a total of 220 pounds.
May 28, 1950—Estimate by marking and recapture with seine of 117 bluegills, 50 bullheads, 1 large bass.
July 11, 1950—Estimate by recapture with seine of 101 to 105 bluegills, 75 bullheads, 1 large bass.
July 12, 1950—Estimate by marking and recovery with seine of 81 to 172 bluegills, 61 bullheads.
August 18, 1950—Estimate by recovery with seine of 94 to 135 bluegills, 49 to 75 bullheads.

REMARKS: Apparently a large share of both bass and bluegills winterkilled 1949-1950.
Study of scales of fish taken in 1950 showed the presence of the 1946 year class of bass and the 1947 and 1949 year classes of bluegills.

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1 Kenneth D. Garlander. 1947. A preliminary report on the fish populations of some farm ponds in Marion County, Iowa. 2 pp. manuscript, on file, Iowa Cooperative Fisheries Research Unit.
Pond 31 Data

NAME: Worth Kenny

LOCATION: NW1/4 Section 4 T74N R20W Marion County, Iowa

SIZE: 0.3 acre

GROUND COVER ON LAND DRAINED: 70 percent bluegrass pasture, 30 percent row crops

SHALLOW WATER VEGETATION: None

STOCKING HISTORY: 1949—16 largemouth bass, 160 bluegills, all fingerlings

MANAGEMENT: None

INSPECTIONS: July 13, 1951—Very abundant minnows, very abundant crayfish and salamander larvae; water colored brown with clay

POPULATION ESTIMATES: Not made

REMARKS: Water level reported to have been very low during winter of 1950-1951
Pond 32 Data

NAME: Clarence King (House)
LOCATION: NE1/4 Section 24 T74N R20W Marion County, Iowa
SIZE: 0.1 acre
GROUND COVER ON LAND DRAINED: Row crops
SHALLOW WATER VEGETATION: None
STOCKING HISTORY: 1943--30 largemouth bass, 200 bluegills, all fingerlings
1948--17 largemouth bass fingerlings
MANAGEMENT: Penced from livestock
INSPECTIONS: July 12, 1950--Young-of-year bullheads, 1 two-inch bluegill; pond muddy with silt
POPULATION ESTIMATES: Not made
REMARKS: None
Pond 33 Data

NAME: Clarence King (South)

LOCATION: NE1/4 Section 24 T74N R20W Marion County, Iowa

SIZE: 0.7 acre

GROUND COVER ON LAND DRAINED: 50 percent row crops, 50 percent bluegrass, brome and cord-grass (Spartina)

SHALLOW WATER VEGETATION: None

STOCKING HISTORY: 1942—150 bluegills, 200 bullheads, size unknown
1946—30 largemouth bass, 300 bluegills, all fingerlings

MANAGEMENT: Fenced from livestock

INSPECTIONS: 1948—Eight-inch to nine-inch bass, adult bluegills
July 12, 1950—Young-of-year bass, young-of-year bluegills, young-of-year bullheads, two-inch bluegills; water low and muddy
June 29, 1951—Young-of-year bass, young-of-year bluegills; two-inch and larger bluegills; water roily with silt
August 30, 1951—Young-of-year bass, young-of-year bluegills, four-inch and larger bluegills; water low and colored gray with clay

POPULATION ESTIMATES: Not made

REMARKS: Study of scales from fish taken in 1950 showed presence of 1946 year class of bass and the 1947, 1948, 1949 year classes of bluegills.

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a Inspection made by Soil Conservation District personnel.
Pond 34 Data

NAME: Asa Mann

LOCATION: SE1/4 Section 32 T75N R20W Marion County, Iowa

SIZE: 0.3 acre

GROUND COVER ON LAND DRAINED: Sparse bluegrass

SHALLOW WATER VEGETATION: Some Potamogeton nodosus Poiret

STOCKING HISTORY: 1949—37 largemouth bass, 237 bluegills, all fingerlings

MANAGEMENT: Fenced from livestock

INSPECTIONS: July 13, 1951—Some young-of-year bass, abundant young-of-year bluegills; 1 two-inch bluegill, some larger bluegills, 1 eight-inch bass; water colored gray with mud

August 30, 1951—Few young-of-year bass, abundant young-of-year bluegills; few two-inch bluegills; water brown with clay

POPULATION ESTIMATES: Not made

REMARKS: None
Pond 35 Data

NAME: Clyde Milner

LOCATION: NW 1/4 Section 9 T76N R20W Marion County, Iowa

SIZE: 0.4 acre

GROUND COVER ON LAND DRAINED: 30 percent bluegrass pasture,
70 percent row crops

SHALLOW WATER VEGETATION: None

STOCKING HISTORY: 1947—80 largemouth bass, 800 bluegills, all
fingerlings
1949—40 largemouth bass fingerlings

MANAGEMENT: None

INSPECTIONS: June 23, 1949—Two-inch and larger bluegills; many
tadpoles
August 9, 1950—Larval tiger salamanders; water low and muddy

POPULATION ESTIMATES: Not made

REMKS: Pond leaked water badly from the time it was built
Apparently winterkilled prior to 1949; did winterkill
1949-1950
Pond 36 Data

NAME: Emory Morkert

LOCATION: SE1/4 Section 31 T75N R20W Marion County, Iowa

SIZE: 0.2 acre

GROUND COVER ON LAND DRAINED: 25 percent in row crops, rest in farm yard and bluegrass

SHALLOW WATER VEGETATION: Cattails, some Potamogeton nodosus, some Alisma subcordatum

STOCKING HISTORY: 1946—30 largemouth bass, 300 bluegills, all fingerlings

MANAGEMENT: None

INSPECTIONS: July 11, 1949—Many crayfish, many larval tiger salamanders

POPULATION ESTIMATES: Not made

REMARKS: None
Pond 37 Data

NAME: Leo Murphy

LOCATION: SE1/4 Section 20 T76N R20W Marion County, Iowa

SIZE: 0.3 acre

GROUND COVER ON LAND DRAINED: Permanent bluegrass pasture

SHALLOW WATER VEGETATION: None

STOCKING HISTORY: 1947—Largemouth bass and bluegills, rates of stocking and size of fish unknown
1949—50 largemouth bass fingerlings

MANAGEMENT: Fenced from livestock

INSPECTIONS: July 12, 1949—Young-of-year bluegills; many two-inch and larger bluegills
July 9, 1951—Abundant young-of-year bass, few large bluegills
August 29, 1951—Abundant young-of-year bass; pond full, brown with plankton algae

POPULATION ESTIMATES: August 3, 1951—Estimate by marking and recovery with seine of 50 bluegills

REMARKS: Partial winterkill of both bass and bluegills reported for winter of 1950-1951
Study of scales of fish taken in 1951 showed that some members of 1951 year class of bass had reached a length of 4.6 inches by August 29.
Pond 36 Data

NAME: Worth Rankin

LOCATION: SE1/4 Section 7 T76N R20W Marion County, Iowa

SIZE: 0.5 acre

GROUND COVER ON LAND DRAINED: 80 percent bluegrass pasture, 20 percent row crops

SHALLOW WATER VEGETATION: Some cattails, considerable Potamogeton and Sagittaria

STOCKING HISTORY: 1944—20 largemouth bass, 250 bluegills, 35 bullheads; all fingerlings

MANAGEMENT: None

INSPECTIONS: July 11, 1949—Some young-of-year bass, many young-of-year bluegills; two-inch bluegills

POPULATION ESTIMATES: Not made

REMARKS: None
Pond 39 Data

NAME: Arlan Rees

LOCATION: SE1/4 Section 6 T76N R20W Marion County, Iowa

SIZE: 0.3 acre

GROUND COVER ON LAND DRAINED: Bluegrass pasture

SHALLOW WATER VEGETATION: None

STOCKING HISTORY: 1944—15 largemouth bass, 150 bluegills, 20 bullheads, all fingerlings

MANAGEMENT: None

INSPECTIONS: July 11, 1949—Many very small bullheads; water low and very muddy

POPULATION ESTIMATES: Not made

REMARKS: Drainage area judged inadequate to fill pond
Pond 40 Data

NAME: Harvey Rees

LOCATION: NE 1/4 Section 5 T76N R20W Marion County, Iowa

SIZE: 0.4 acre

GROUND COVER ON LAND DRAINED: 1949—Bluegrass pasture
1951—Row crops

SHALLOW WATER VEGETATION: Some young willow

STOCKING HISTORY: 1945—20 largemouth bass, 150 bluegills,
10 bullheads, all fingerlings
1949—20 bass fingerlings
1950—Some catfish added by the farmer

MANAGEMENT: Fenced from livestock

INSPECTIONS: July 11, 1949—Many young-of-year bullheads; two-
inch and larger bluegills; water very muddy
July 9, 1951—Some young-of-year bullheads; some adult
black bullheads; water colored brown with suspended clay

POPULATION ESTIMATES: Not made

REMARKS: Apparently winterkill occurred 1949-1950 or 1950-1951
Pond 41 Data

NAME: Roorda Brothers

LOCATION: SW1/4 Section 33 T77N R15W Marion County, Iowa

SIZE: 0.6 acre

GROUND COVER ON LAND DRAINED: 70 percent in bluegrass pasture,
30 percent in row crops

SHALLOW WATER VEGETATION: None

STOCKING HISTORY: 1944--20 largemouth bass, 250 bluegills, 35
bullheads, all fingerlings
1949--35 largemouth bass, 350 bluegills, all fingerlings

MANAGEMENT: Treated with rotenone in 1949 and restocked
Fenced from livestock

INSPECTIONS: August 15, 1949--Very many black bullheads of all
sizes
August 9, 1950--Young-of-year bluegills; yearling bluegills
four to five inches long

POPULATION ESTIMATES: August 16, 1949--Estimates by marking and
recapture with seine of 3,222 to 3,362 black bullheads
August 17, 1949--Estimates by recapture with seine of 879
to 1,168 bluegills
August 15, 1949--Estimate by recovery following rotenone
treatment of 3,373 bullheads, for a total of 173 pounds

REMARKS: This pond showed successful reproduction of bass and
bluegills in 1952, and furnished excellent fishing that year.
Pond 42 Data

NAME: Walter Schneider

LOCATION: NE1/4 Section 19 T74N R21W Marion County, Iowa

SIZE: 2.0 acres

GROUND COVER ON LAND DRAINED: 50 percent row crops, 50 percent waste land and grassed waterways

SHALLOW WATER VEGETATION: Some cattails, much Potamogeton

STOCKING HISTORY: Original stocking, date unknown, consisted of green sunfish, white crappies, black bullheads
1948—100 largemouth bass, 1000 bluegills, all fingerlings

MANAGEMENT: Open to public fishing and swimming

INSPECTIONS: July 12, 1950—Young-of-year crappies; two-inch to three-inch bluegills, five-inch crappies; water somewhat muddy
July 30, 1951—Young-of-year bluegills; four-inch bluegills, five-inch crappies; water clear
August 28, 1951—Young-of-year bass, few young-of-year bluegills; adult minnows, four-inch bluegills, 1 four-inch black bullhead; water colored brown with algae

POPULATION ESTIMATES: Not made

REMARKS: Bullheads were being caught by fishermen in 1950 but were not captured by the inspection seine. Seining for population estimates was prevented by presence of tree stumps and other debris.
Pond 43 Data

NAME:  L. C. (John) Shivvers

LOCATION:  NW1/4 Section 7 T75N R20W Marion County, Iowa

SIZE:  0.2 acre

GROUND COVER ON LAND DRAINED:  85 percent pastured birds-foot trefoil, 15 percent bare ground of roadbed

SHALLOW WATER VEGETATION:  Some cattails, some Scirpus

STOCKING HISTORY:  1946—50 largemouth bass, 200 bluegills, all fingerlings
1948—Some bullheads stocked by neighbor boy
1949—50 bass fingerlings added in July after inspection showed many small bluegills and bullheads

MANAGEMENT:  None, pond open to sheep

INSPECTIONS:  June 29, 1949—Two-inch and larger bluegills, five-inch bullheads
July 7, 1949—2 nine-inch bass, many two-inch to three-inch bluegills, very many five-inch bullheads
July 18, 1950—Young-of-year bluegills; nine-inch bass, three-inch bluegills
June 27, 1951—1 young-of-year bass; 4 five-inch bluegills; water colored gray with clay
August 29, 1951—Young-of-year bass, young-of-year bluegills; five-inch bluegills; water colored gray with clay

POPULATION ESTIMATES:  July 20, 1950—Estimate by marking and recovery by seine of 18 bluegills, 51 bullheads, 7 bass

Pond Data

NAME: Ralph Shivers

LOCATION: NW 1/4 Section 6 T75N R20W Marion County, Iowa

SIZE: 0.4 acre

GROUND COVER ON LAND DRAINED: Permanent bluegrass pasture

SHALLOW WATER VEGETATION: Much cattail, very much Potamogeton
nodosus and Potamogeton foliosus

STOCKING HISTORY: 1945—35 largemouth bass, 350 bluegills; all
fingerlings

MANAGEMENT: Fenced from livestock
1949—Partial removal of emergent vegetation

INSPECTIONS: 1947 a —Successful reproduction of both bass and
bluegills
June 29, 1949—Young-of-year bass, young-of-year bluegills,
two-inch and larger bluegills
June 28, 1951—Young-of-year bass, young-of-year bluegills;
two-inch and larger bluegills; water very clear
August 22, 1951—Young-of-year bass, young-of-year blue-
gills; water clear

POPULATION ESTIMATES: 1950—Not made, because of heavy vegetation
1951—Estimates by marking and recovery with traps of 1,802
bluegills, for a total of 176 pounds

REMARKS: August 23, 1951—Nine man-hours of fishing effort
captured 69 bluegills, for 7 2/3 fish per man-hour
Study of scales from fish taken August 28, 1951 showed that
bass between three inches and seven inches long were
1951 young-of-year

a Inspection made by Soil Conservation District personnel.
Pond U5 Data

NAME: Doney Smith

LOCATION: NE1/4 Section 23 T75N R20W Marion County, Iowa

SIZE: 0.3 acre

GROUND COVER ON LAND DRAINED: Bluegrass pasture

SHALLOW WATER VEGETATION: Cutgrass (Leersia), Potamogeton

STOCKING HISTORY: 1935—Unknown numbers of largemouth bass and bluegill fry
1945—Some fish, unknown as to kind, size, and number, stocked from an adjoining pond after partial winterkill during 1944-1945

MANAGEMENT: Fenced from livestock
Farmer has always restricted personal and public fishing to "save" the fish

INSPECTIONS: 1950—Young-of-year bass, young-of-year bluegills were visible from shore
July 11, 1951—Young-of-year bass, young-of-year bluegills; some two-inch and larger bluegills; pond full, water dark brown with plankton algae
August 29, 1951—Young-of-year bass, young-of-year bluegills; some two-inch and larger bluegills; water brown in color with plankton algae

POPULATION ESTIMATES: July 13, 1951—Estimate by marking and recovery with seine of 800 bluegills for a total of 71 pounds of bluegills and 11 pounds of bass

REMARKS: Study of scales from fish taken in 1950 and 1951 showed the presence of the 1947, 1948, 1949, 1950 and 1951 year classes of bass
This pond reportedly produced bluegills up to 11 inches long during the years 1946 and earlier
Fond 46 Data

NAME: Earl Smith
LOCATION: SE1/4 Section 15 T74N R20W Marion County, Iowa
SIZE: 0.1 acre
GROUND COVER ON LAND DRAINED: Timber and bluegrass
SHALLOW WATER VEGETATION: None
STOCKING HISTORY: 1942—75 bullheads, size unknown
1944—10 largemouth bass, 100 bluegills, all fingerlings
1948—15 largemouth bass, all fingerlings
MANAGEMENT: None
INSPECTIONS: 1948—Young-of-year bluegills
July 14, 1950—Twelve-inch bass, two-inch and larger bluegills; water muddy with clay
July 19, 1950—Young-of-year bullheads; two-inch and larger
bluegills, adult black bullheads; water muddy with clay
June 26, 1951—Two-inch and larger bluegills, four-inch
black bullheads; water muddy with clay
POPULATION ESTIMATES: July 21, 1950—Estimates by marking and
recovery with seine of 71 to 74 bluegills, 84 to 99 black
bullheads, 1 bass, for a total of 17 to 19 pounds
REMARKS: Study of scales from a 13.5 inch bass taken July 14,
1950, showed the bass was of the 1946 year class

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*aInspection made by Soil Conservation District personnel*
Pond 47 Data

NAME: Worth Smith

LOCATION: SW1/4 Section 20 T75N R20W Marion County, Iowa

SIZE: 0.25 acre

GROUND COVER ON LAND DRAINED: 50 percent mixed weeds and grasses, 50 percent row crops

SHALLOW WATER VEGETATION: None

STOCKING HISTORY: 1945—25 largemouth bass, 190 bluegills, 15 bullheads, all fingerlings

MANAGEMENT: Fenced from livestock

INSPECTIONS: July 11, 1949—2 young-of-year bluegills, three-inch black bullheads, one unidentified minnow; water very muddy

June 29, 1951—Few four-inch bullheads, 1 three-inch minnow; water very muddy with clay

POPULATION ESTIMATES: Not made

REMARKS: Farmer reported catching some bluegills in 1950
Pond 48 Data

NAME: R. G. Steehoek

LOCATION: SEL/4 Section 22 T76N R13W Marion County, Iowa

SIZE: 0.3 acre

GROUND COVER ON LAND DRAINED: 20 percent bluegrass, 80 percent row crops

SHALLOW WATER VEGETATION: None

STOCKING HISTORY: 1944—30 largemouth bass, 300 bluegills, 40 bullheads, all fingerlings

MANAGEMENT: None

INSPECTIONS: July 13, 1949—Many two-inch to three-inch bluegills

POPULATION ESTIMATES: Not made

REMARKS: None
Pond 49 Data

NAME: Burt Stevenson

LOCATION: SW1/4 Section 14 T76N R20W Marion County, Iowa

SIZE: 0.3 acre

GROUND COVER ON LAND DRAINED: 80 percent bluegrass, 20 percent row crops

SHALLOW WATER VEGETATION: None

STOCKING HISTORY: 1944—20 largemouth bass, 250 bluegills, 35 bullheads, all fingerlings
1947—30 largemouth bass, 300 bluegills, all fingerlings
1950—15 largemouth bass yearlings

MANAGEMENT: None

INSPECTIONS: 1946a—Only bluegills and bullheads present when pond drained to repair dam
July 13, 1949—Four-inch bluegills; water muddy
1950—Young-of-year bullheads; four-inch bluegills, four-inch black bullheads; water low and muddy
July 31, 1951—1 young-of-year bullhead; many insects and frogs; water very muddy with clay

POPULATION ESTIMATES: Not made

REMARKS: None

a Inspection made by Soil Conservation District personnel.
Pond 50 Data

NAME: Dave Stittsworth

LOCATION: SW1/4 Section 23 T76N R20W Marion County, Iowa

SIZE: 0.4 acre

GROUND COVER ON LAND DRAINED: 80 percent in bluegrass, 20 percent in row crops

SHALLOW WATER VEGETATION: Willows, cottonwoods and some Potamogeton nodosus

STOCKING HISTORY: 1945—25 largemouth bass, 190 bluegills, 15 bullheads; all fingerlings

MANAGEMENT: Fenced from livestock

INSPECTIONS: Young-of-year bass, young-of-year bluegills
    July 13, 1943—Young-of-year bluegills; adult bluegills;
    water muddy

POPULATION ESTIMATES: Not made

REMARKS: None

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*a Inspection made by Soil Conservation District personnel.*
Pond 51 Data

NAME: Sam Trent

LOCATION: SE1/4 Section 32 T74N R21W Marion County, Iowa

SIZE: 0.8 acre

GROUND COVER ON LAND DRAINED: Contoured and terraced crops (1949—Oats, 1950 and 1951—red clover)

SHALLOW WATER VEGETATION: Some cattails, some Potamogeton nodosus, some Potamogeton foliosus

STOCKING HISTORY: 1947—25 largemouth bass, 250 bluegills, all fingerlings

MANAGEMENT: Not fenced from livestock in 1949 but so fenced in 1950 and 1951

INSPECTIONS: July 11, 1949—Young-of-year bluegills; two-inch and larger bluegills, 4 ten-inch bass, 1 large black bullhead

June 13, 1950—Young-of-year bluegills; eleven-inch bass, four-inch and larger bluegills

June 27, 1951—Very abundant young-of-year bass; two-inch bluegills, 1 five-inch bluegill

August 28, 1951—Young-of-year bass three to five inches long; two-inch to three-inch bluegills; tremendous numbers of bullfrog tadpoles; water brown with plankton algae

POPULATION ESTIMATES: June 15, 1950—Estimates by marking and recovery with seine of 873 bluegills, 56 bass, 18 bullheads

August 19, 1950—Estimate by marking and recovery with seine of 892 bluegills

REMARKS: Study of scales of fish taken in 1950 and 1951 showed the 1947, 1949 and 1951 year classes of bass present; the 1947, 1948, 1949 and 1950 year classes of bluegills present
Pond 52 Data

NAME: Louis Van Hoekel

LOCATION: SE1/4 Section 9 T77N R19W Marion County, Iowa

SIZE: 0.3 acre

GROUND COVER ON LAND DRAINED: Permanent grass

SHALLOW WATER VEGETATION: Some cattails, some willows

STOCKING HISTORY: 1946--75 largemouth bass, 225 bluegills, all fingerlings

MANAGEMENT: None

INSPECTIONS: August 9, 1950--2 young-of-year bass, young-of-year bluegills; two-inch bluegills; 1 ten-inch bass; water low and clear

POPULATION ESTIMATES: Not made

REMARKS: None
Pond 53 Data

NAME: Henry Van Steenwyk
LOCATION: NW1/4 Section 27 T75N R20W Marion County, Iowa
SIZE: 0.4 acre
GROUND COVER ON LAND DRAINED: Bluegrass pasture
SHALLOW WATER VEGETATION: None
STOCKING HISTORY: 1948—40 largemouth bass, 400 bluegills, all fingerlings
MANAGEMENT: None
INSPECTIONS: July 21, 1950—Two-inch and larger bluegills; water muddy
POPULATION ESTIMATES: Not made
REMARKS: None
Pond 54 Data

NAME: Lloyd Van Zante

LOCATION: NE1/4 Section 36 T76N R18W Marion County, Iowa

SIZE: 0.3 acre

GROUND COVER ON LAND DRAINED: Permanent bluegrass

SHALLOW WATER VEGETATION: 50 percent of shallow water in cattails

STOCKING HISTORY: 1949—15 largemouth bass and 150 bluegills, all fingerlings, after rotenone treatment

MANAGEMENT: Treated with rotenone in 1949 to eliminate population of black bullheads

INSPECTIONS: August 9, 1950—Young-of-year bullheads; yearling bluegills five-inches long, adult bullheads
August 2, 1951—Young-of-year bass, young-of-year bluegills; two-inch bluegills, 1 ten-inch bass, 1 five-inch bluegill; pond full, water muddy

POPULATION ESTIMATES: Not made

REMARKS: Rotenone treatment did not eliminate the black bullheads
Pond 55 Data

NAME: Walter Von Zosimeron

LOCATION: NE1/4 Section 35 T77N R18W Marion County, Iowa

SIZE: 0.4 acre

GROUND COVER ON LAND DRAINED: 90 percent bluegrass, 10 percent contoured row crops

SHALLOW WATER VEGETATION: None

STOCKING HISTORY: 1946—40 bluegills, 400 bullheads, all fingerlings
1947—60 largemouth bass fingerlings
1950—60 largemouth bass, 600 bluegills, all fingerlings

MANAGEMENT: Fenced from livestock; treated with rotenone in 1949 and again in 1950 to eliminate black bullheads

INSPECTIONS: August 9, 1950—Young-of-year bullheads
July 31, 1951—Young-of-year bluegills, yearling bluegills five inches long; water brown with plankton algae; farmer report of seeing bass yearlings
October 11, 1951—Very numerous 3/4 inch bluegills visible along shore

POPULATION ESTIMATES: August 14–16, 1950—506 black bullheads weighing 127.8 pounds recovered after rotenone treatment

REMARKS: Farmer report for 1952 indicated that both bass and bluegills spawned successfully during the summer
Pond 56 Data

NAME: Ernest Viers

LOCATION: SW1/4 Section 29 T77N R21W Marion County, Iowa

SIZE: 0.5 acre

GROUND COVER ON LAND DRAINED: Bluegrass pasture

SHALLOW WATER VEGETATION: None

STOCKING HISTORY: 1949—15 largemouth bass, 150 bluegills, all fingerlings

MANAGEMENT: Fenced from livestock

INSPECTIONS: July 12, 1951—No fish present; many salamander larvae; pond full, water dark brown with plankton algae

POPULATION ESTIMATES: Not made

REMARKS: None
Pond 57 Data

NAME: Raymond Vinson

LOCATION: SE1/4 Section 30 T75N R20W Marion County, Iowa

SIZE: 0.3 acre

GROUND COVER ON LAND DRAINED: Bluegrass

SHALLOW WATER VEGETATION: Considerable cattails

STOCKING HISTORY: 1945—20 largemouth bass, 200 bluegills, all fingerlings

MANAGEMENT: Fenced from livestock

INSPECTIONS: July 12, 1950—Young-of-year bass, young-of-year bluegills; water muddy with fine clay
July 30, 1951—Some young-of-year bass, some young-of-year bluegills; a few two-inch bluegills; water muddy with fine clay

POPULATION ESTIMATES: Not made

REMARKS: Study of scales from fish taken in 1950 showed the presence of the 1949 year class of bass, the 1947, 1948, 1949 year classes of bluegills
Pond 5s Data

NAME: Gary Vogelaar

LOCATION: SE1/4 Section 15 T76N R16W Marion County, Iowa

SIZE: 0.6 acre

GROUND COVER ON LAND DRAINED: 50 percent in hay crops, 50 percent in row crops

SHALLOW WATER VEGETATION: Cattails

STOCKING HISTORY: Original stocking unknown

MANAGEMENT: None

INSPECTIONS: July 19, 1948: Young-of-year bass, young-of-year bluegills; yearling bass, yearling bluegills; adult green sunfish
August 9, 1950: Young-of-year bass, young-of-year bluegills; two-inch and larger bluegills, ten-inch bass; pond level low and water muddy
August 30, 1951: Few young-of-year bass, abundant young-of-year bluegills; water muddy with gray clay

POPULATION ESTIMATES: July 20, 1948: 244 bluegills, 94 black bullheads, 26 green sunfish, 91 orange-spotted sunfish, plus unestimated bass, crappies, carp and buffalo

REMARKS: Pond used as source of bass and bluegills in 1946, and as a source of bass in 1948

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1 Kenneth D. Carlander. 1948. Manuscript data, on file, Iowa Cooperative Fisheries Research Unit.
Pond 59 Data

NAME: E. F. Woods

LOCATION: SW1/4 Section 4 T74N R20W Marion County, Iowa

SIZE: 0.2 acre

GROUND COVER ON LAND DRAINED: 50 percent miscellaneous grasses and weeds, 50 percent row crops

SHALLOW WATER VEGETATION: Some cattails, some Potamogeton nodosus

STOCKING HISTORY: 1947--10 largemouth bass, 100 bluegills, all fingerlings
July 12, 1949--30 bass fingerlings

MANAGEMENT: None

INSPECTIONS: June 30, 1949--Young-of-year bluegills, two-inch to three-inch bluegills; numerous tadpoles, water very muddy with clay
June 29, 1951--Young-of-year bass, many young-of-year bluegills, 6 four-inch bluegills; water dark brown with plankton algae
August 29, 1951--Young-of-year bass, young-of-year bluegills; many bullfrog tadpoles; water brown with plankton algae

POPULATION ESTIMATES: Not made

REMARKS: Study of scales of fish taken in 1951 showed the presence of the 1949 year class of bass
The 1949 stocking was experimental in nature
Pond 60 Data

NAME: Howard Worthington

LOCATION: SE1/4 Section 32 T77N R20W Marion County, Iowa

SIZE: 0.4 acre

GROUND COVER ON LAND DRAINED: Permanent bluegrass pasture

SHALLOW WATER VEGETATION: None

STOCKING HISTORY: 1944—20 largemouth bass, 250 bluegills, 30 bullheads, all fingerlings

MANAGEMENT: Fenced from livestock, but area inside of fence occasionally grazed by sheep

INSPECTIONS: July 11, 1949—Newly-hatched young-of-year bluegills; two-inch and larger bluegills, 1 eleven-inch bass
July 9, 1951—Young-of-year bass, young-of-year bluegills, young-of-year bullheads; water dark brown with plankton algae, some blue-green algae present
August 31, 1951—Water brown with plankton algae

POPULATION ESTIMATES: July 12, 1951—Estimate by marking and recovery with seine of 1,418 bluegills; bass and bullheads not estimated

REMARKS: None